AD-A132 002 AUSTRALIAN OCEANOGRAPHIC DATA CENTRE BULLETIN 16(U) 1/1
AUSTRALIAN OCEANOGRAPHIC DATA CENTRE NORTH SYDNEY
MAY 83

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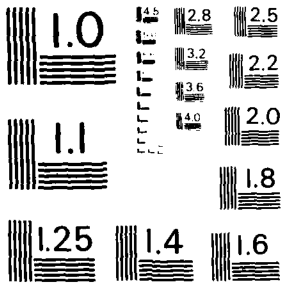

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AR003170

ADA132002

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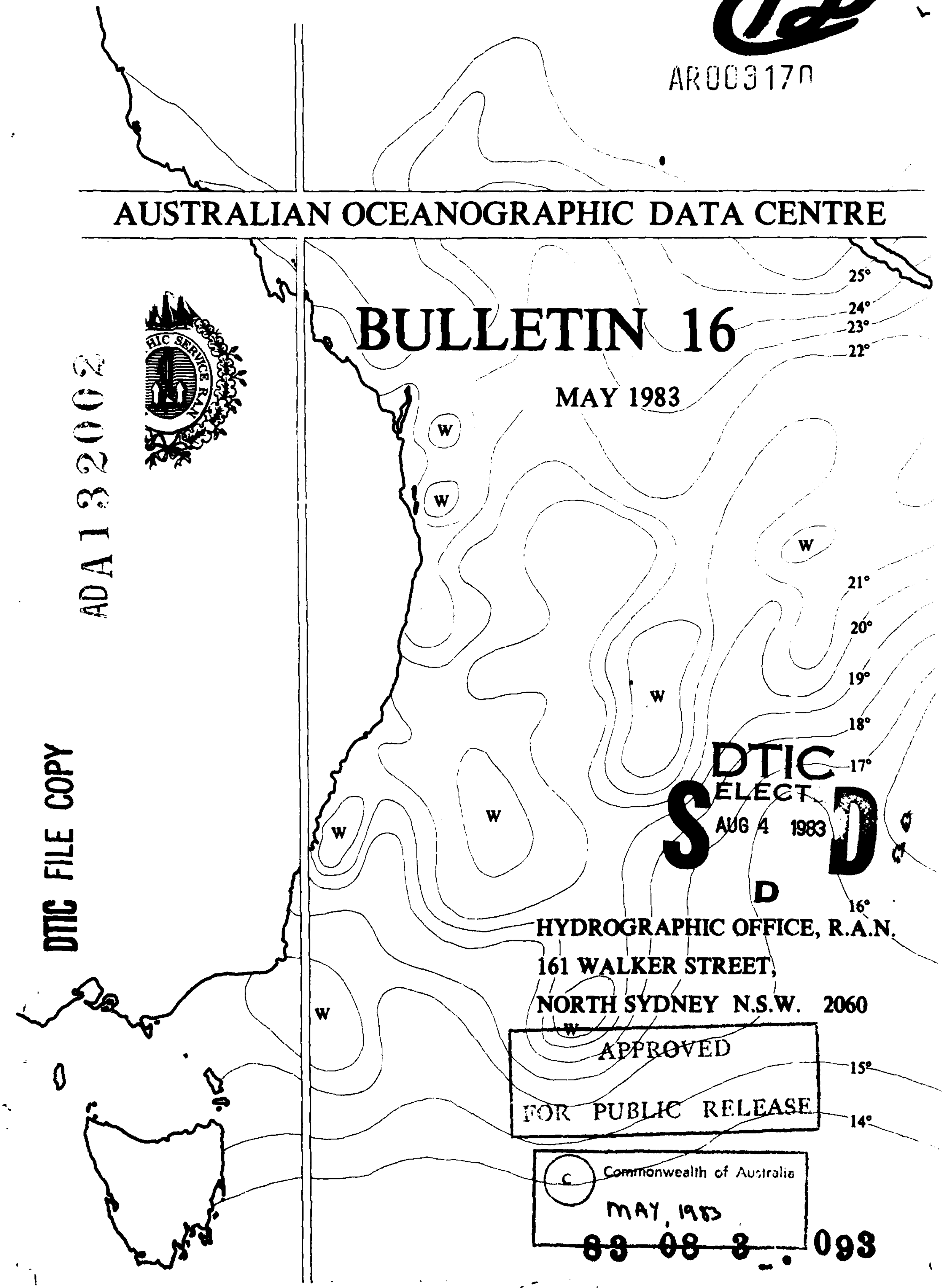
AUSTRALIAN OCEANOGRAPHIC DATA CENTRE

BULLETIN 16

MAY 1983



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HYDROGRAPHIC OFFICE, R.A.N.
161 WALKER STREET,
NORTH SYDNEY N.S.W. 2060

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MAY, 1983

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A.O.D.C. BULLETIN NO. 16 APRIL 1983: The Australian Oceanographic Data Centre (A O D C.) Bulletin is an occasional publication. It is informal and the opinions of the authors are not necessarily those of the Hydrographer.

CORRESPONDENCE: Any correspondence regarding the Bulletin or any article submitted for publication should be addressed to:– Officer-in-Charge, Australian Oceanographic Data Centre, P O Box 1332, North Sydney, Australia, 2060

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AODC DATA MANAGEMENT SYSTEM

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Introduction

The Australian Oceanographic Data Centre (AODC) was formed in 1964 as a section of the Hydrographic Service of the Royal Australian Navy. The centre was established to improve the communication of oceanographic data within the Australian Defence Forces.

It was recognised at an early stage that involvement with the civilian marine science community both nationally and internationally would provide considerable benefits to the Navy. For this reason the AODC became part of the Intergovernmental Oceanographic Commission's (IOC) network of national data centres. The establishment of this liaison has resulted in the AODC having access to data collected by a large number of countries in the waters surrounding Australia.

Initially the data archived was restricted to ocean temperature profiles collected using mechanical bathythermograph probes (MBT's). The data was converted into a digital form by hand. The archiving and retrieval aspects were also conducted manually.

In the early 1970's the Royal Australian Navy introduced the Expendable Bathythermograph probe (XBT). This temperature measuring device can be deployed from a fast moving ship and so is more applicable to the RAN's military tasks. The XBT has a higher deployment rate which resulted in an overload on the AODC's manual digitizing activities. In 1973 steps were initiated to obtain a degree of automation in the digitisation process. In the interim however, an agreement was reached with the American National Oceanographic Data Center to digitise Australian collected XBT's. The data was returned on magnetic tape and formed the basis of todays bathythermal data bank.

This data was stored on a commercial system and the original software came from a number of sources. Due to financial constraints the system suffered from a number of problems and was inefficient in several key areas. In 1979 the Hydrographer acquired a computerised chart production system. Known as AUTOCHART it has a semi-automated digitising capability that is used by the AODC to convert analogue temperature profiles into a digital form. The acquisition of AUTOCHART co-incided with an extensive modification of the original data bank software. Many of the problems relating to retrieval and display were overcome and the new system had a greatly enhanced flexibility.

AUTOCHART and the modified data bank software increased the AODC's data handling capabilities and indirectly resulted in a rapid increase in data holdings. In early 1979, before the new facilities were available the AODC was archiving 12,000 MBT and XBT observations. This figure rose to 80,000 in July 1980. In 1981 the geographical area of interest to the AODC was expanded to encompass the Indian Ocean. Data for this larger area was acquired from the world Data Centre in Washington and together with data coming from national sources such as the CSIRO increased the data holdings to the present level of 132,000 temperature profiles.

Present System

The RAN is our major source of XBT data providing over 4,000 profiles per year. The AODC checks this data and adds it to the data bank once it has been digitised. We also provide advice to the Navy on the deployment of XBT's. This has resulted in a large improvement in the success rate of the probes deployed, with the number of profiles retained increasing from 30% to over 80% in three years. This improvement has resulted in a large increase in the number of profiles that are retained for inclusion in the data bank.

The present data bank consists of ocean temperature data stored on magnetic tapes that are updated, retrieved, analysed, and displayed by a suite of programmes developed specifically for this task. The use of magnetic tape as the primary storage medium has occurred for two reasons.

1. Economy. With the large quantity of data held (in the vicinity of 50 million characters) magnetic tape is the most cost effective storage medium. It has been estimated that the cost of disk storage at todays commercial rates would be approximately $500 per day.
2. There is currently no requirements to have the data on-line. The turn around time to respond to queries on the present data base is not excessive.

During the initial development of the system it was considered that geographical position would be the main retrieval key, so the data is stored in a geographically sorted sequence

The present system software can be divided into two sections

1. Update section which adds newly acquired data to the existing data tapes
2. Retrieval section which incorporates the analytical and output routines.

Update

Digital data is received from a number of organisations and is usually in the supplying agency's internal format. Before the data is added to the data bank the record structure must be altered to the AODC's format. The format conversion consists of altering the sequence of various items within the record or observation. The Update software contains a number of modules for converting different data structures to AODC's format. There is also the added flexibility of allowing new conversion modules to be included when data is acquired from organisations with which we have had no previous contact.

Once the newly acquired data has been reformatted it goes through a number of check programmes. These are relatively simple and are used to check various ranges and values. For example: temperature measurements exceeding 32 degrees C or less than −2 degrees C are rejected.
The check programme also verifies the position of each profile. By checking the position of two consecutive profiles against the time of the probe deployment an estimation of ships speed can be made. If the ships estimated speed exceeds 25 knots the data is flagged and included in an error file. The error file is examined and any editing or deletions take place. Once the editing is complete the Update software sorts the data into the correct geographical sequence and it is merged with the existing data bank. Back-up copies of the tape are made to ensure data security.

Retrieval

The retrieval software selects the specified data from the data bank, analyses it and provides the correct outputs. There are two main retrieval accesses to the data bank.

1. Retrieving specific data. Data collected during a particular cruise can be retrieved by using an identification number which is allocated to each cruise. This number is unique world wide and the AODC has been allocated a series of these by World Data Centre 'A'. Each Australian cruise entered into the data bank is given one of these numbers. All data within the IOC network is therefore identifiable by its cruise number. This retrieval key is not used frequently.
2. Specific area. Most enquiries concern a specific area and the user is interested in all or a sub-set of data within this area. In this instance the geographical limits are the primary retrieval key. Additional keys can be implemented if required using a hierarchical approach. For example: A specified area can be subdivided by date and time criteria such as all the data in March. The following date time units are used:
   1. Year
   2. Month
   3. Day
   4. Hour
   5. Minute

Each of these units has a default value allowing the maximum within each unit to be retrieved if it is not specified. This approach is very flexible and allows a large number of retrieval combinations which cover the majority of data requests.

The outputs currently available consist of two main types:

1. Provides details on each individual observation and includes a lineprinter representation of the original profile.
2. Calculates a number of basic statistics on different combinations of data on both horizontal and vertical planes.

Other Data Types

The AODC also holds a number of catalogues and inventories of international data holdings especially those within the IOC system. Most of these are outlined in the Department of Science Inventory of 'Marine Science Data Bases'.

Future Development of the AODC

Over the next few years the AODC will be expanding its activities by archiving a wider range of oceanographic parameters. This growth is the result of a recent Defence Oceanographic Policy that recognises 15 parameters that are of direct interest. Also, the increasing need for improved environmental support in the changing area of anti-submarine warfare.

In response to these demands the AODC is developing a computer system that will archive an increased number of parameters and provide a wider range of products and services. The new system is still very much in the design stage and many of the technical aspects have yet to be finalised.

The system will comprise of mini computer hardware and specifically developed application software linked to a commercially available data base package. The majority of the data will be stored off-line on magnetic tape or removeable disk packs. Like the present system the new computer will have two main areas.

1. Update
2. Retrieval

UPDATE – The Update section will be comprised of a number of check routines, reformatting modules and a comprehensive editing facility. Data will pass through these routines before it is added to the main data files and the system will automatically generate inventories of the data acquisition. The check routines will be more sophisticated than those on the present system allowing both automatic checks and manual checks using a graphics terminal.

RETRIEVAL – Retrieval will also be similar to the present system although having a larger number of outputs. A line printer will provide basic graphics while a small plotter will be used to produce a better quality product. The new system will be able to use AUTOCHART facilities to produce high quality graphics. Outputs will also be available on magnetic tape so that research organisations with their own facilities can undertake additional analysis. Parameter versus parameter outputs such as temperature/salinity curves will also be possible.
The data will be managed by a Data Base Management System (DBMS).

The exact package has not yet been decided on, however, the system that is used must have considerable flexibility in the areas of updating and retrieval together with the capability of allowing the addition of new data parameters with little or no modification to existing application software.

All data bases are a compromise between the updating and retrieval activities. These two aspects have been carefully examined to determine which is the most important for AODC's operations. Since the new computer is not a real-time data acquisition system, the retrieval and analysis areas have the higher priority. While updating is still important it does not have any effect on the day to day operations and can be undertaken as a batch operation.

The traditional data base approaches such as Network and Heirarchical types will be examined although some initial preference is being given to the newly developed relational data base. This data base has a number of important advantages over the other approaches. It will allow the addition of new data parameters and accept changes in data formats with virtually no modifications. This aspect is of considerable importance to AODC as new data parameters will be added to the system as the requirement arises. The relational data base would simplify this process and greatly reduce software maintenance, allowing the programmers to concentrate on the application software. The only penalty involved in using this approach is the increase in operating overheads but this is more than compensated for by the increased flexibility.

Data acquired by the AODC that was collected as part of a site specific project, will generally be maintained separately as an individual file. The project data will be included in the data inventory but will not generally be divided into separate parameter files. There are three reasons for this

1. It will assist in maintaining security for commercial data.
2. It will overcome data quality problems. Data collected commercially for a particular project may not meet scientific accuracy levels, and so would contaminate the existing data files if included.
3. Detailed documentation concerning the data, method of collection and accuracy can be maintained with the data to aid future exchange.

With the new system the AODC will be attempting to maintain an up to date file describing other Australian physical oceanographic data repositories. The main basis of this file will be the IOC Reports of Observations and Samples Collected by Oceanographic Programmes (ROSCOP). This consists of a form that gives generalised details on the types of data collected during individual cruises. The advantages of participating in such a scheme are obvious, and this aspect should be of considerable benefit.

The new system is to be known as HYDROCOMP and is expected to be operational in 1985.

Data Quality

One area of data management that is frequently mentioned is data quality. Over the last few years the AODC has put the primary emphasis of quality on the contributing authhority. At this stage it is considered that the collecting organisation has considerable expertise in the area of concern which ensures a high level of confidence. However, each acquisition of data is examined on a case by case basis. Also, all data entering the data bank undergoes a number of checks. In the future, with a wider range of archived data, it is likely that the AODC will request the assistance from other organisations to assist in quality assurance.

Every effort will be made to ensure that the quality of data will be maintained. However, it is inevitable that with the quantities of data involved some bad data will be archived. In order to exclude this various filtering techniques will be employed.

AODC BATHYTHERMAL DATA OUTPUTS

The AODC is presently capable of providing a number of bathythermal data outputs which are available to all organisations and individuals involved in oceanographic research

Currently 132,711 bathythermal observations are held in the data bank for the area 20°00'E., 150°00'W., 25°00'N., 70°00'S. These observations consist of both XBT and MBT records. Retrieval of data is based on·

- i) location: i.e., latitude and longitude given in degrees and minutes 1 minute subdivisions are possible and
- ii) time: i.e., expressed in year, month, days.

Computer Outputs – Examples

No.1 BATHYTHERMOGRAPH – DATA INVENTORY GRID.

Shows the number of observations in any given area. A 10 by 10 matrix gives the approximate location and total number of observations for a given area.

No.2 BATHYTHERMOGRAPH INVENTORY LISTING

Produces a listing of latitude, longitude, month, year, cruise and sequence numbers for all bathys within the specified limits.

No.3 DEPTH SUMMARY LISTING FOR TEMPERATURES

Provides analysed information which can be used for such things as studying temperature profile changes during different seasons.

No.4 THERMOCLINE SUMMARY

Gives information on layer depth. This can be calculated in one of two ways.

1. Averaging Method

   The temperature at each profile point is subtracted from the average temperature for all shallower profile points. When the difference equals or exceeds the values defined (eg 0.5°C) the previous point is taken as the top of the thermocline.

2. Gradient or Slope Method

   The thermocline is calculated by testing the temperature gradient between successive profile points against the defined slope (eg 1.0° change in 25m.). When the gradient exceeds the defined value the previous point is taken as the thermocline top.

A depth value can be included to remove temperature changes due to the afternoon effect. Eg: – input 10m. and the calculations exclude any values above that depth.

No.5 BATHYTHERMOGRAPH DATA INVENTORY GRID – AT X METRES

This report is similar to the 'squares' except that information is given for a specified depth (eg. 250m.). The mean temperature, standard deviation and number of observations is given.

No.6 PRINTER PLOT – 1

This can be used to reproduce any individual observation in analogue form. Header information provides details on time and location of the observation.

No.7 PRINTER PLOT – 2

Provides mean temperature and standard deviation for a specified area.

No.8 OVER PLOT – 1

Over plots of each observation. Header information gives details on the first and last observation showing the time range covered and the area.

No.9 OVER PLOT – 2

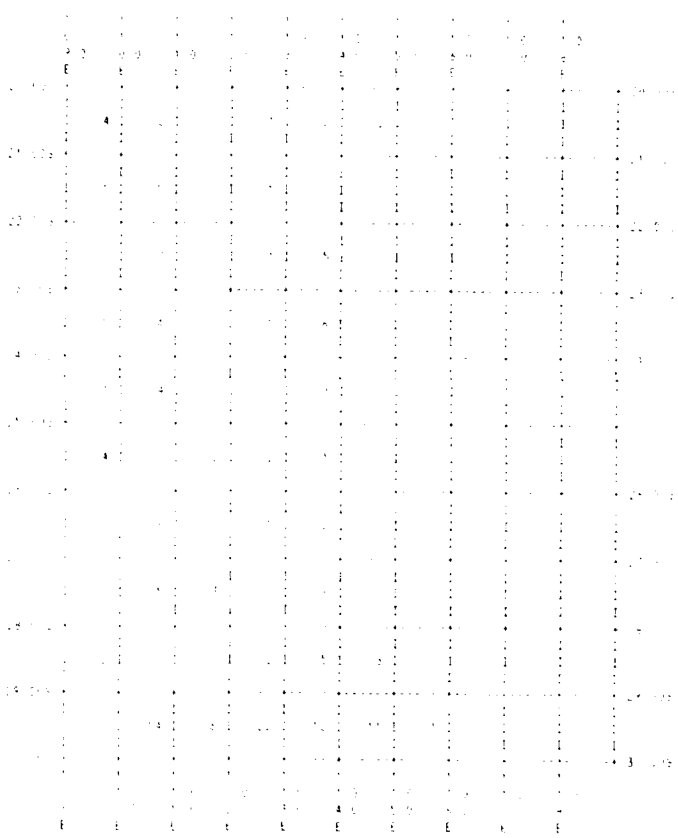
Provides a mean temperature and standard deviation for a specified area.

The retrieval programs are totally flexible providing data in any size area (down to minute squares) for any time period. For example: 35°–00' to 35°–05' by 150°–10' to 150°–12'E during the last week in September and the first two days in October. The outputs are usually provided with data from both MBT and XBT banks although these can be provided separately.

NO.1 BATHYTHERMOGRAPH-DATA INVENTORY GRID.

DATE 83 [illegible] TIME [illegible] [illegible] DATA INVENTORY GRID [illegible] SURFACE

AREA COVERED 30.00S TO [illegible] FOR THE MONTHS [illegible] YEAR [illegible]
DAYS [illegible] TIME [illegible]
TOTAL NUMBER OF BATHYTHERMOGRAPHS [illegible]



NO.2 BATHYTHERMOGRAPH INVENTORY LISTING.

```
0INVENTORY
  LIMITS OK
1    DATE  83/04/27.    TIME   10.50.22.          BATHYTHERMOGRAPH  INVENTORY  LISTING                                   PAGE     1
           AREA COVERED  30.00S TO  20.00S BY   110.00E TO 113.00E          FOR THE MONTHS  SEP- OCT             YEARS  1900 - 1999
           DAYS   1-15   TIME   0002-24002
```

LAT	LONG	DATE	CRUISE	SEQ		LAT	LONG	DATE	CRUISE	SEQ		LAT	LONG	DATE	CRUISE	SEQ		LAT	LONG	DATE	CRUISE	SEQ:
20 00S	110 00E	62/ 9	6384	299	*	20 00S	110 00E	62/ 9	37918	15	*	21 30S	110 00E	62/ 9	6384	300	*	21 30S	110 00E	62/ 9	37918	17
22 35S	112 08E	59/10	37079	8	*	23 00S	110 00E	62/ 9	6384	301	*	23 00S	110 00E	62/ 9	37918	16	*	24 29S	110 00E	62/ 9	6384	302
24 53S	112 58E	67/ 9	21959	79	*	25 00S	112 55E	67/ 9	21959	78	*	25 33S	112 13E	62/ 9	37820	854	*	26 00S	110 00E	62/ 9	6384	303
26 54S	110 12E	63/ 9	6572	171	*	25 48S	110 36E	64/ 9	37820	856	*	26 00S	110 00E	62/ 9	37918	19	*	26 56S	110 12E	64/ 9	37943	14
26 21S	112 50E	67/ 9	21959	77	*	27 30S	110 00E	62/ 9	6384	304	*	27 36S	110 24E	63/ 9	6572	170	*	27 23S	111 34E	59/10	37052	18
28 29S	111 09E	69/10	23430	4	*	28 33S	111 26E	69/10	23430	5	*	28 59S	111 26E	69/10	23430	6	*	28 52S	111 43E	59/10	37052	17
28 49S	112 56E	69/10	23430	19	*	29 00S	110 00E	62/ 9	6384	305	*	29 0S	110 54E	63/ 9	6572	169	*	29 22S	110 33E	70/ 9	23351	1
29 00S	110 00E	62/ 9	37918	20	*	29 02S	110 51E	63/ 9	37946	2	*	29 31S	111 56E	69/10	23430	7	*	29 11S	111 30E	59/10	37079	2
29 36S	112 41E	68/10	22772	5	*	29 55S	112 00E	68/10	22772	10	*	29 59S	112 51E	69/10	23430	14	*	29 57S	112 20E	69/10	23430	15
29 06S	112 15E	69/10	23430	16	*	29 08S	112 36E	69/10	23430	17	*	29 30S	112 37E	69/10	23430	18	*	22 06S	110 30E	71/ 9	60802	464
23 45S	111 13E	71/ 9	60802	471	*	25 13S	111 46E	71/ 9	60802	482	*	26 54S	112 38E	71/ 9	60802	492	*	29 12S	112 58E	75/ 9	60998	3
29 06S	112 57E	75/ 9	60998	4	*	29 35S	112 56E	76/10	60985	10	*	29 14S	112 47E	76/10	60985	11	*	29 00S	112 39E	76/10	60985	12
29 01S	112 58E	76/10	60985	13	*																	

TOTAL NUMBER OF BATHYTHERMOGRAPHS   49

UPRINTER PLOT MEAN
LIMITS OK
1 DATE 83/04/22. TIME 11.07.05. DEPTH SUMMARY LISTING FOR TEMPERATURE

AREA COVERED 29.00S TO 19.00S BY 109.00E TO 114.00E FOR THE MONTHS SEP- OCT YEARS 1900 - 1999
DAYS 1-31 TIME 0002-2400Z

DEPTH IN METRES	MAX TEMP DEG C	AVG TEMP DEG C	MIN TEMP DEG C	NUMBER	STANDARD DEVIATION
0	25.2	21.5	17.6	111	1.7
5	25.2	21.5	17.6	111	1.7
10	25.2	21.4	17.7	111	1.7
15	25.2	21.4	17.5	110	1.7
20	25.2	21.4	17.4	110	1.7
25	25.2	21.4	17.4	109	1.7
30	25.2	21.3	17.5	108	1.7
35	25.2	21.4	17.4	104	1.7
40	25.3	21.3	17.3	103	1.7
45	25.5	21.3	17.0	102	1.8
50	25.8	21.3	16.8	99	1.8
60	26.2	21.1	16.7	92	1.9
70	26.6	21.0	16.6	91	1.9
80	26.9	20.8	16.4	89	1.9
100	27.4	20.4	16.0	87	1.9
125	26.3	19.9	15.7	77	1.7
150	24.6	19.7	16.6	55	1.4
200	21.3	18.3	15.1	53	1.2
250	19.0	16.5	13.2	46	1.3
300	16.8	14.6	12.1	31	1.4
350	14.9	12.5	10.7	30	1.1
400	13.3	11.1	9.4	28	.9
450	13.3	10.2	8.8	20	1.0
500	0.0	0.0	0.0	0	0.0
550	0.0	0.0	0.0	0	0.0
500	0.0	0.0	0.0	0	0.0

NO.3 DEPTH SUMMARY LISTING FOR TEMPERATURES.

40.4 THERMOCLINE SUMMARY.

```
THERMOCLINE AVERAGE DT.=0.5
 LIMITS OK
    DATE  83/04/28.     TIME   12.46.49.          THERMOCLINE  SUMMARY
        AREA COVERED  30.00S TO  28.00S BY   109.00E TO 112.00E         FOR THE MONTHS  SEP- OCT              YEARS  1900 - 1999
        DAYS   1-15   TIME   G00Z-2400Z
        MIN. DEPTH    THCL. CRIT          DEPTH     TEMP      YEAR MTH DAY  HOUR     CRUISE    SEQ      LAT       LONG
          10.0M       .50C                75.0M     17.1        69  10   4     4      23430      4     28.29 S  111.09 E
          10.0M       .50C                95.0M     16.9        69  10   4     6      23430      5     28.33 S  111.26 E
          10.0M       .50C                85.0M     17.2        69  10   4     9      23430      6     28.59 S  111.26 E
          10.0M       .50C                45.0M     18.1        59  10  12    10      37052     17     28.52 S  111.43 E
          10.0M       .50C                85.0M     19.1        62   9  14    13       6384    305     29.00 S  110.00 E
          10.0M       .50C                40.0M     19.7        63   9   6     1       6572    169     29. 0 S  110.54 E
          10.0M       .50C               220.0M     18.0        70   9  11     6      23351      1     29.22 S  110.33 E
          10.0M       .50C                85.0M     19.1        62   9  14    13      37918     20     29.00 S  110.00 E
          10.0M       .50C                50.0M     18.3        63   9   6     8      37946      2     29.02 S  110.51 E
          10.0M       .50C                90.0M     16.9        69  10   4    23      23430      7     29.31 S  111.56 E
          10.0M       .50C               130.0M     18.2        59  10  12     8      37079      2     29.11 S  111.30 E
        AVERAGE DEPTH       =  90.9          MINIMUM     =  40.0
        STANDARD DEVIATION =  47.6           MAXIMUM     = 220.0

        OBSERVATION COUNT  =    11
```

NO.5 BATHYTHERMOGRAPH DATA INVENTORY GRID-AT Y METRES.

DATE 83 04 [illegible] TIME [illegible] COMBINED BATHYTHERMOGRAPH - DATA INVENTORY GRID - AT 50 METRES

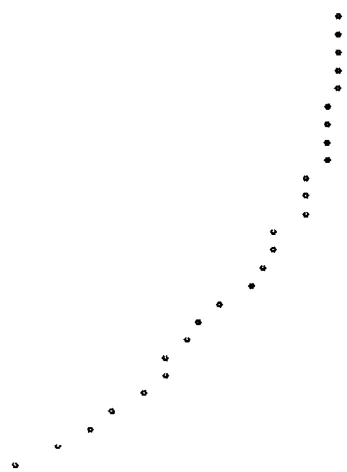
AREA COVERED 30.00S TO 20.00S BY 109.00E TO 118.00E FOR THE MONTHS SEP-OCT YEARS [illegible]
DAYS 1-31 TIME 0000-2400

TOTAL NUMBER OF BATHYTHERMOGRAPHS = [illegible]
AVERAGE TEMPERATURE = 20.[illegible] MINIMUM TEMPERATURE = [illegible]
STANDARD DEVIATION = 2.[illegible] MAXIMUM TEMPERATURE = [illegible]
UPPER FIGURE IN SQUARE IS AVERAGE TEMPERATURE, MIDDLE FIGURE IS BATHYTHERMOGRAPH COUNT
AND LOWER FIGURE IS STANDARD DEVIATION

	109.0E	110.0E	111.0E	112.0E	113.0E	114.0E	115.0E	116.0E	117.0E
20.00S–21.00S	22.8 / 4 / [illegible]	23.2 / 2 / [illegible]		[illegible] / [illegible] / 0.0	[illegible] / [illegible] / .8	25.[illegible] / [illegible] / [illegible]			
21.00S–22.00S	[illegible] / 1 / 0.0	22.8 / 5 / [illegible]		22.5 / 1 / [illegible]					
22.00S–23.00S		[illegible] / 3 / .4		[illegible] / 1 / [illegible]	[illegible] / 5 / [illegible]				
23.00S–24.00S	[illegible] / 1 / [illegible]	22.3 / 4 / .5	[illegible] / [illegible] / .2	21.4 / [illegible] / [illegible]	[illegible] / [illegible] / [illegible]				
24.00S–25.00S	[illegible] / 1 / [illegible]	[illegible] / 4 / [illegible]		[illegible] / [illegible] / [illegible]	[illegible] / [illegible] / [illegible]				
25.00S–26.00S	[illegible] / 4 / .5		[illegible] / [illegible] / .4	[illegible] / 1 / [illegible]	[illegible] / [illegible] / [illegible]				
26.00S–27.00S	[illegible] / [illegible] / 0.0	[illegible] / [illegible] / [illegible]	[illegible] / [illegible] / [illegible]	[illegible] / [illegible] / [illegible]					
27.00S–28.00S		[illegible] / 5 / .4	[illegible] / [illegible] / [illegible]		[illegible] / [illegible] / [illegible]				
28.00S–29.00S	18.9 / [illegible] / .4		[illegible] / [illegible] / [illegible]	[illegible] / [illegible] / [illegible]	[illegible] / 4 / [illegible]				
29.00S–30.00S	16.9 / [illegible] / [illegible]	[illegible] / [illegible] / [illegible]	[illegible] / [illegible] / [illegible]	[illegible] / [illegible] / .8	[illegible] / [illegible] / [illegible]	[illegible] / 4 / .4	[illegible]		

NO.6 PRINTER PLOT-1.

DEPTH TEMPERATURE 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32



DEPTH (M)	TEMPERATURE (C)	
0	22.0	
10	22.0	
20	22.0	
30	22.0	
40	22.0	
50	21.8	50
60	21.7	
70	21.7	
80	21.6	
90	21.3	
100	21.2	100
110	21.2	
120	20.8	
130	20.7	
140	20.5	
150	20.2	150
160	19.7	
170	19.3	
180	19.1	
190	18.7	
200	18.5	200
210	18.2	
220	17.7	
230	17.2	
240	16.7	
250	16.0	250

DAY	MONTH	YEAR	TIME	LATITUDE	LONGITUDE	REFERENCE NO.	CONSEC NO.
8	9	64	1500	2656 S	11012 E	37943	14

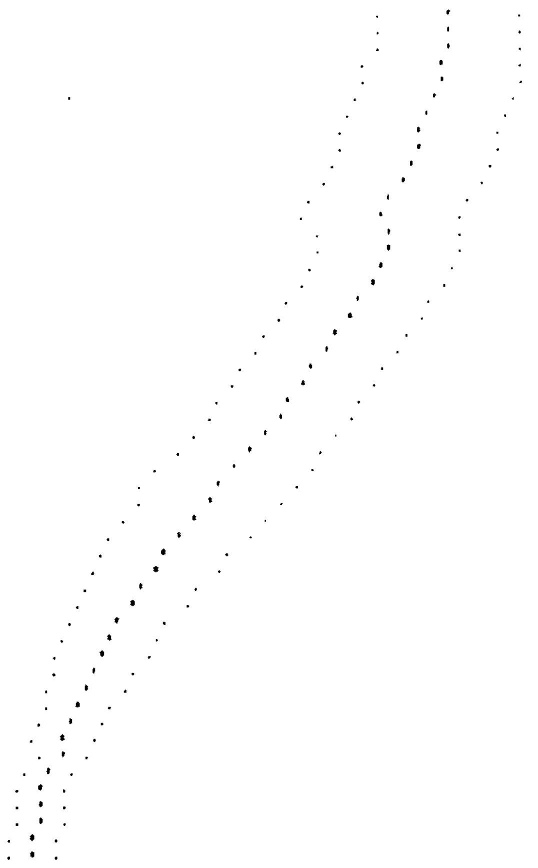
NO.7 PRINTER PLOT-2.

PRINTER PLOT MEAN
LIMITS OK

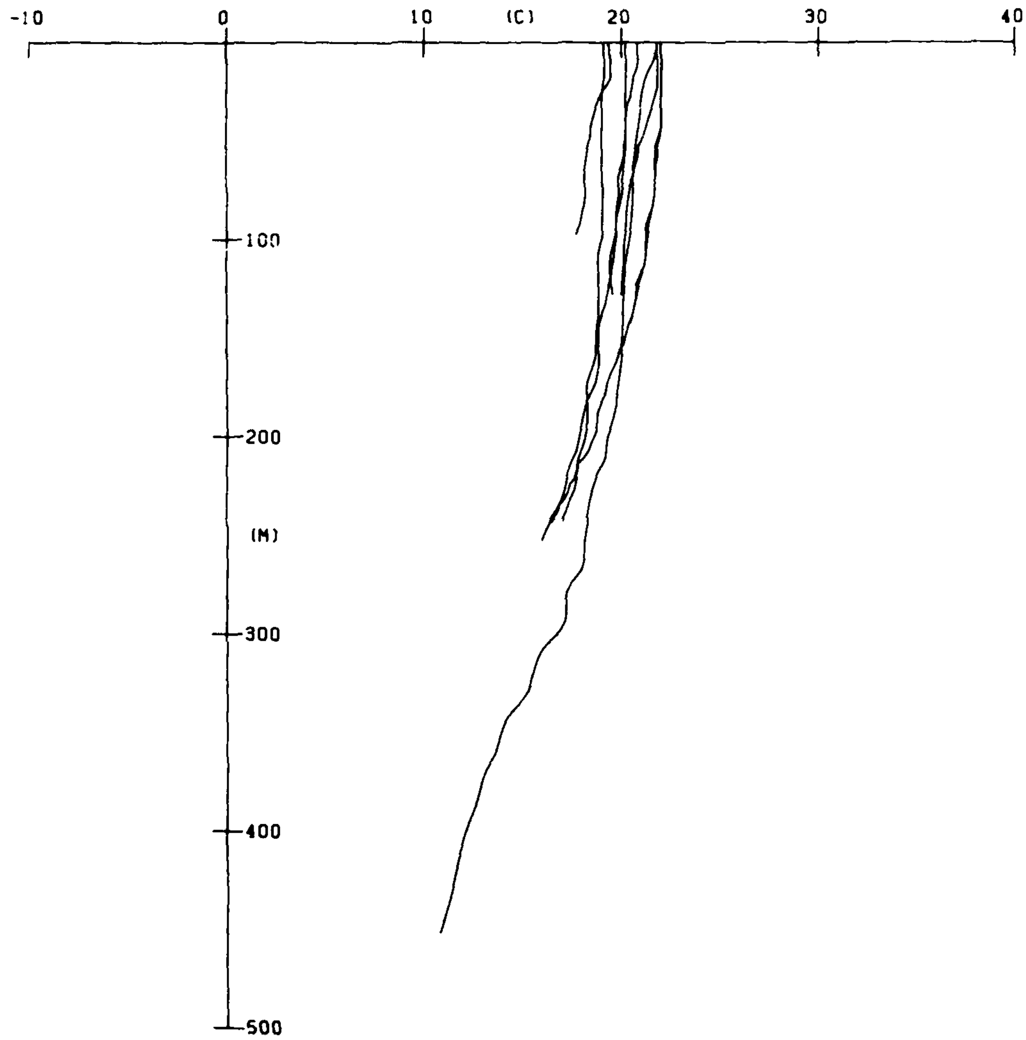
	DAY	MONTH	YEAR	TIME	LATITUDE	LONGITUDE	REFERENCE NO.	CONSEC NO.
	1	9	8	0000	2959 S	10904 E		
TO	30	10	79	2359	2000 S	11519 E		

DEPTH TEMPERATURE 7.0 9.0 11.0 13.0 15.0 17.0 19.0 21.0 23.0 25.0 27.0 29.0

DEPTH (M)	TEMPERATURE (C)	
0	20.4	
10	20.4	
20	20.4	
30	20.4	
40	20.3	
50	20.1	50
60	20.0	
70	19.8	
80	19.6	
90	19.4	
100	19.3	100
110	19.0	
120	18.8	
130	18.8	
140	18.9	
150	18.7	150
160	18.4	
170	18.2	
180	17.9	
190	17.6	
200	17.3	200
210	16.9	
220	16.6	
230	16.4	
240	16.0	
250	15.6	250
260	15.3	
270	14.9	
280	14.6	
290	14.2	
300	13.9	300
310	13.5	
320	13.2	
330	12.9	
340	12.6	
350	12.2	350
360	12.0	
370	11.7	
380	11.5	
390	11.3	
400	11.0	400
410	10.9	
420	10.8	
430	10.5	
440	10.4	
450	10.1	450
460	10.0	
470	9.8	
480	9.8	
490	9.7	
500	9.6	500

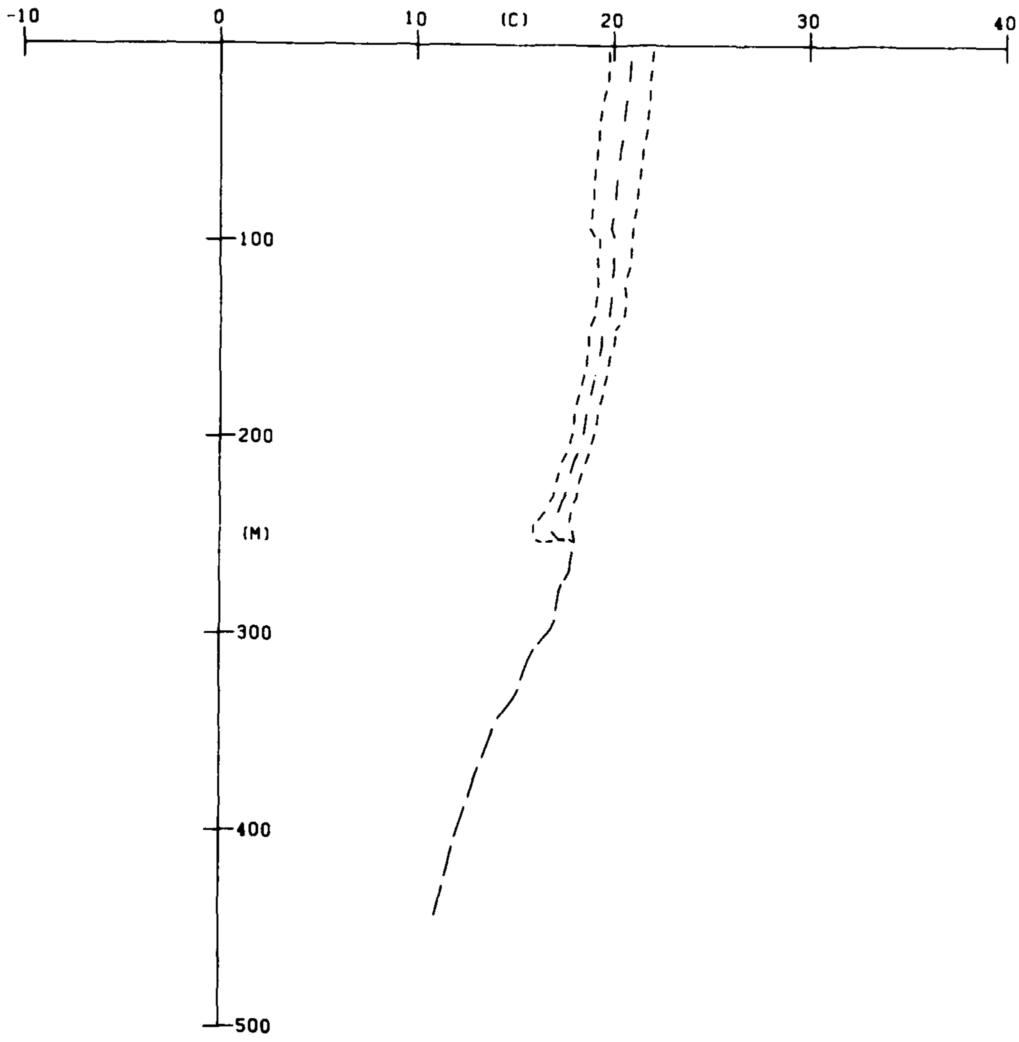


NO.8 OVER PLOT-1.



LATITUDE: 29.00 S to 25.00 S
LONGITUDE: 110.00 E to 113.00 E
MONTHS 9 to 9
DAYS 1 to 15

NO.9 OVER PLOT-2.



LATTITUDE: 29.00 to
LATTITUDE; 29.00 S to 25.00 S
LONGITUDE; 110.00 E to 112.00 E
MONTHS 9 to 9
DAYS 1 to 15

SOUTHERN OCEAN ENVIRONMENTAL BRIEF

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Hydrographic Service,
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Australia 2060

1. METEOROLOGY

General Circulation

The Antarctic continent is generally under the influence of a large anticyclone. To the north is the circumpolar trough of low pressure which dominates the area between 60°S and 65°S throughout the year. The seasonal movement of the circumpolar trough is small, generally lying between 62°S and 64°S in January and 61°S and 65°S in July. The remainder of the region north of the circumpolar trough is in the westerly wind belt, south of the subtropical anticyclone belt. The predominant wind flow (over 75% the year round) is westerly, north of 60°S. South of 65°S the predominant wind direction is east to southeast. Local topographical and diurnal effects can produce significant variations to this easterly flow in coastal Antarctic waters.

In general there is no marked seasonal change in the character of the westerly flow and winds of 20–30 kts can be expected 40% of the time.

Wind

Table 1 below shows an increase in frequency of gale force winds or greater during winter and spring, with a consequential decrease in the frequency of light winds experienced during these seasons.

TABLE 1: PERCENTAGE FREQUENCY OF WINDS BETWEEN 45°S AND 60°S

	Gale Force or stronger	Light Winds 10kts	20 to 30kts
SUMMER	7%	25%	40%
AUTUMN	10%	20%	40%
WINTER	15%	15%	40%
SPRING	15%	15%	40%

Depressions

The major synoptic feature of the region is the depression and associated fronts to the north. The weather patterns follow the classic text-book model as there is virtually no landmass to interrupt the westerly flow. However there are also small fast moving depressions which are a major hazard to shipping. They may move at speeds in excess of 50 knots and cause sharp increases of wind speed to strong gale and storm force.

Temperatures

Mean air temperatures are given in Table 2. Air temperatures are graded from 45° to the continental coastline.

TABLE 2: MEAN AIR TEMPERATURES (°C)

	SUMMER	AUTUMN	WINTER	SPRING
NORTH	13	11	07	10
SOUTH	−02	−13	−18	−14

Weather

Over Subantarctic waters there is little seasonal change in the meann amount of total cloud cover. 5/8ths or more total cloud cover occurs 75% of the time. Precipitation occurs on average one day in three, and 25% of all precipitation recorded is frozen precipitation.

South of 65°S, precipitation falls mainly as light to moderate snow showers. Precipitation, within this region, in the form of rain or freezing rain is rare — for example no rain has ever been recorded at McMurdo Sound.

Visibility

In general, good visibility predominates, and reports of exceptional visibility are frequent. Sea fog is rare. However visibility is reduced quite frequently by rainstorms and thick drizzle with very low clouds. Extensive sea spray during strong winds also creates visibility problems.

Sea and Swell

Sea state being directly related to wind speed, the percentage frequency of the height of sea waves can be extracted from Table 1. For example, moderate to rough seas can be expected on 40% of occasions the year round.

The predominant swell direction (over 90%) is southwest to northwest. Often two swells exist with one being southwesterly and the other northwesterly. There is little seasonal variation and a heavy swell over (4m) can be expected on 40% of occasions. A moderate swell (2-4m) can be expected 50% of the time.

Maximum wave heights and periods for Summer and Winter are shown in figures 1 and 2.

2. OCEANOGRAPHY

Introduction

The Southern Ocean is bounded to the south by the Antarctic continent and to the north by the Subtropical Convergence (STC) — a hydrological limit whose position varies in this sector between 40°S and 48°S according to season. In oceanographic terms the Southern Ocean is relatively simple with zonal homogeneity and circumpolar continuity of the general circulation.

Bathymetry

The Southern Ocean is divided into three principal basins. The Indian — Antarctic Basin south and southwest of Australia being bounded on the west by the Kerguelen Plateau, marked on the surface by the Kerguelen Archipelago and Heard Island, and in the east by a complex ridge system linking Cape Adare with New Zealand and Tasmania marked on the surface by Balleny and Macquarie Islands. The basin has a mean depth of over 4000m and the ridges generally have depths over 2000m with occasional mountains and islands.

Ocean Currents

The circulation of Southern Ocean Waters is apparently the most simple in the world because of the wind system, the shape of the basin, and the lack of continental obstacles. The main flow is the west wind drift or Southern Ocean Current between about 40°S and 60°S.

The current is not strictly west to east but has a north-east component due to the coriolis force. Temporal and spatial variations in direction are caused by the movement of major weather systems. The obstruction of Australia and Tasmania causes some water to go north and turns the principle flow south eastwards. The flow rate is put at 2 to 3 knot and instantaneous values of 1½ knots have been measured in the region of the Antarctic Convergence.

A belt of mainly clockwise edddies lies between the southern limit of the Southern Ocean Current and the coastline of Antarctic (within a few hundred miles of the coast). On the southern side of the eddies is a discontinuous ring of west-going currents, typical current rate is ½ to 1 knot and is said to flow up to 3 knots at times.

Sea-Surface Temperature

Mean sea surface temperatures for the four seasons are shown in figures 4 – 7

Ice and Icebergs (Figure 8)

There are two distinct forms of ice found in the Southern Ocean – icebergs and sea ice. The icebergs are formed from freshwater brought about by the compression of snow (the polar ice cap is over 2000m thick). In spite of the individual mass of icebergs their influence on the ocean is slight. In contrast sea ice has important effects. During winter a layer of ice with a mean thickness of 2m forms around the Antarctic Continent to about 60°S. The ice has a comparatively low salinity and therefore the water beneath a relatively high salinity. Over the summer period the majority of the sea ice together with the accumulated snow melts, consuming the majority of the available solar radiation, producing a cold, comparatively fresh surface layer.

Surface Discontinuties (Figure 9)

As mentioned above, the northern limit of the Southern Ocean is a hydrological boundary, the subtropical convergence, STC. The STC is not a sharp boundary but a zone where the tropical surface waters entrained towards the southeast by circulation of the southern part of the subtropical anticyclone meet the Subantarctic water drawn to the east-northeast by the west wind drift. It is generally marked by a strong temperature gradient between 10 and 14°C in winter and 14 and 18°C in summer but is not well-defined in the Australian sector. Its track is sinuous and position fluctuates within 100nm of its mean position.

In the Australian sector the ocean may be divided into three zones: Antarctic, Complex or Antarctic Polar Frontal Zone, and Subantarctic. The Polar Front or Antarctic convergence is the northern boundary of the Antarctic zone. The Polar Front is more distinct and better localised than the STC. It manifests itself at the surface by a rapid variation of surface temperature of 2 to 3°C in the vicinity of the 2° isotherm in winter and the 5° isotherm in summer. Its position varies up to 60nm either side of its mean position.

The Subantarctic Front divides the Antarctic Polar Frontal Zone from the Subantarctic Zone. It is marked on the surface by a steep temperature gradient.

Thermal Structure

Data is very sparse in this region, statistical samples small, and different authors have interpreted the data available in different ways. However, for purposes of this short brief, simple conclusions may be drawn with respect to typical profiles and sonar ranges that may be expected.

Antarctic Zone Figure 10 shows typical temperature, salinity and velocity profiles for the Antarctic Zone. In this region the surface waters are subjected to the most extreme climatic conditions, which affect the waters to depths of up to 200m. In winter the surface is cooled to freezing point (−1.85° to −1.88°C) and ice forms. In summer there is comparatively little heating as ice reflects 50% of solar radiation and snow 65 – 80%. Also the latent heat of fusion of ice is high consequently the melting sea ice consumes a great part of the solar radiation. It is only in zones without ice that layers of warmer water (50 – 80m thick) will be found. Thus because of the irregular distribution of pack ice due to wind and current action, surface temperature and salinity will be very irregular.

Under this upper layer of water is a water mass (known as Antarctic Circumpolar water) found to depths of 3000 metres which is homogeneous, warmer and saltier than the water above it, and uniformly distributed around the continent. In this region active mixing takes place between the Antarctic circumpolar water and Antarctic upper water which results in increased amounts of nutrients in the upper water making the region biologically very fertile.

Below 3000 metres is found dense, cold (−0.5°C) Antarctic bottom water. (This is the most dense water in the open ocean and is found in all deep ocean basins).

Complex and Subantarctic Regions. Between the Antarctic Convergence and the Subtropical convergence, climatic conditions differ strongly from those of the Antarctic region. The temperature of air and water rise notably (from 2° to 14°C), precipitation is more abundant, and there is no question of freezing even in the dead of winter. These zones are intermediate between the Antarctic proper and the tropical region. Figures 11 and 12 are temperature, salinity and velocity profiles for these regions.

The hydrological structure of these regions is more complex than the Antarctic zone; it is divided in five layers rather than three. The lower three layers are the same water masses as are found in the Antarctic zone. These are overlain between 200 – 600m by a mixture of water enntrained from the tropical region and Antarctic water, and in upper 200 metres is superficial water whose salinity varies with latitude according to the abundance of precipitation.

Detection of Icebergs

12. There are no infallible signs of the proximity of a berg. The only sure way is to see it, so that too much reliance on radar or any of the possible signs is dangerous. Radar may give warning of large icebergs in time to take avoiding action, but it cannot be relied on to detect bergy bits and growlers. Bergy bits are large pieces of land ice about the size of a cottage, growlers are smaller – about the size of a grand piano. Both can rip open even ice – strengthened ships, especially if there is any sea running.

13. However, radar is an invaluable aid in detecting ice, but its limitations must always be borne in mind. Absence of an indication of ice on the radar screen does not necessarily mean that there is no dangerous ice near the ship. The limitations of radar in detecting ice are listed in the Mariner's Handbook.

14. Icebergs are good sonar reflectors.

15. **Signs of Pack Ice.** There are two reliable signs of pack ice. One is ice blink whose characteristic light effects in the sky once seen, can never be mistaken. It may sometimes be seen at night. Ice blink is observed some time before the ice itself over the horizon. It is rarely, if ever, produced by icebergs, but it always distinct over consolidated and extensive pack

16. The second reliable sign of pack ice is the abrupt smoothing of the sea and the gradual lessening of the ordinary ocean swell. These are sure indicators of pack ice to windward.

Ice Charts

17. Meteorological satellites in polar orbit enable experts to map the ice distribution. The United States Fleet Weather Facility, Suitland, Maryland, U.S.A. produces weekly ice charts which are broadcast for facsimile reception by ships.

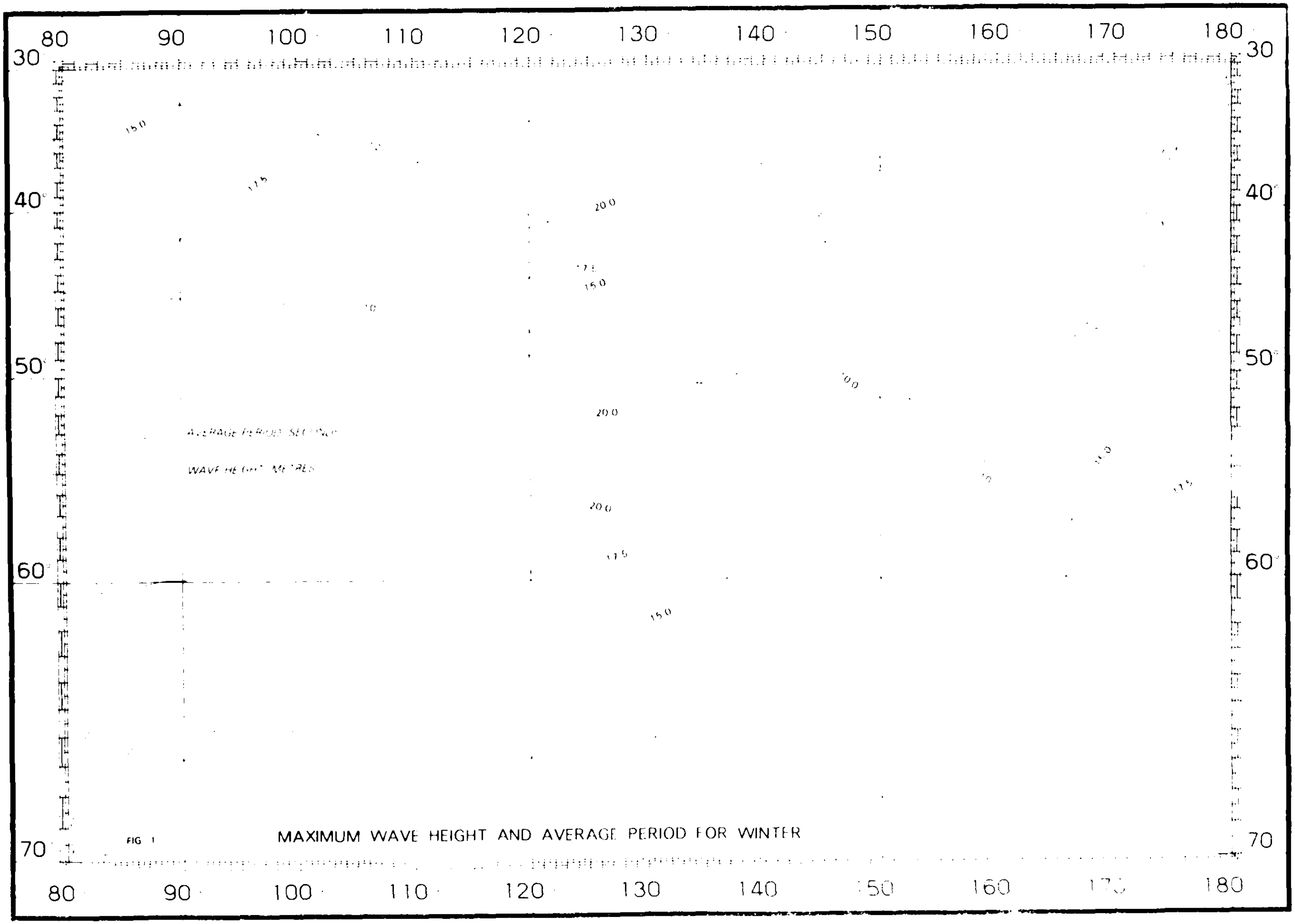
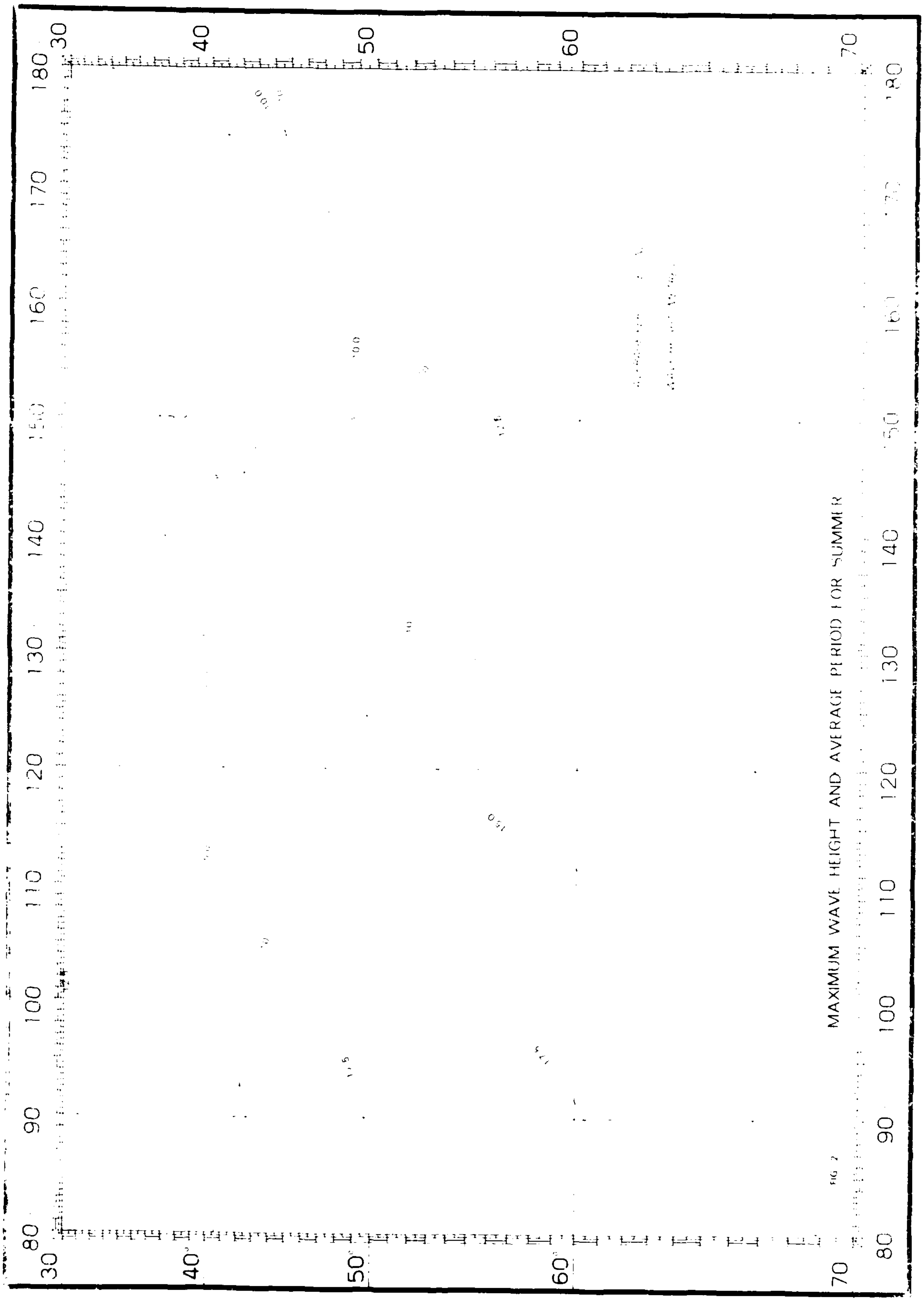
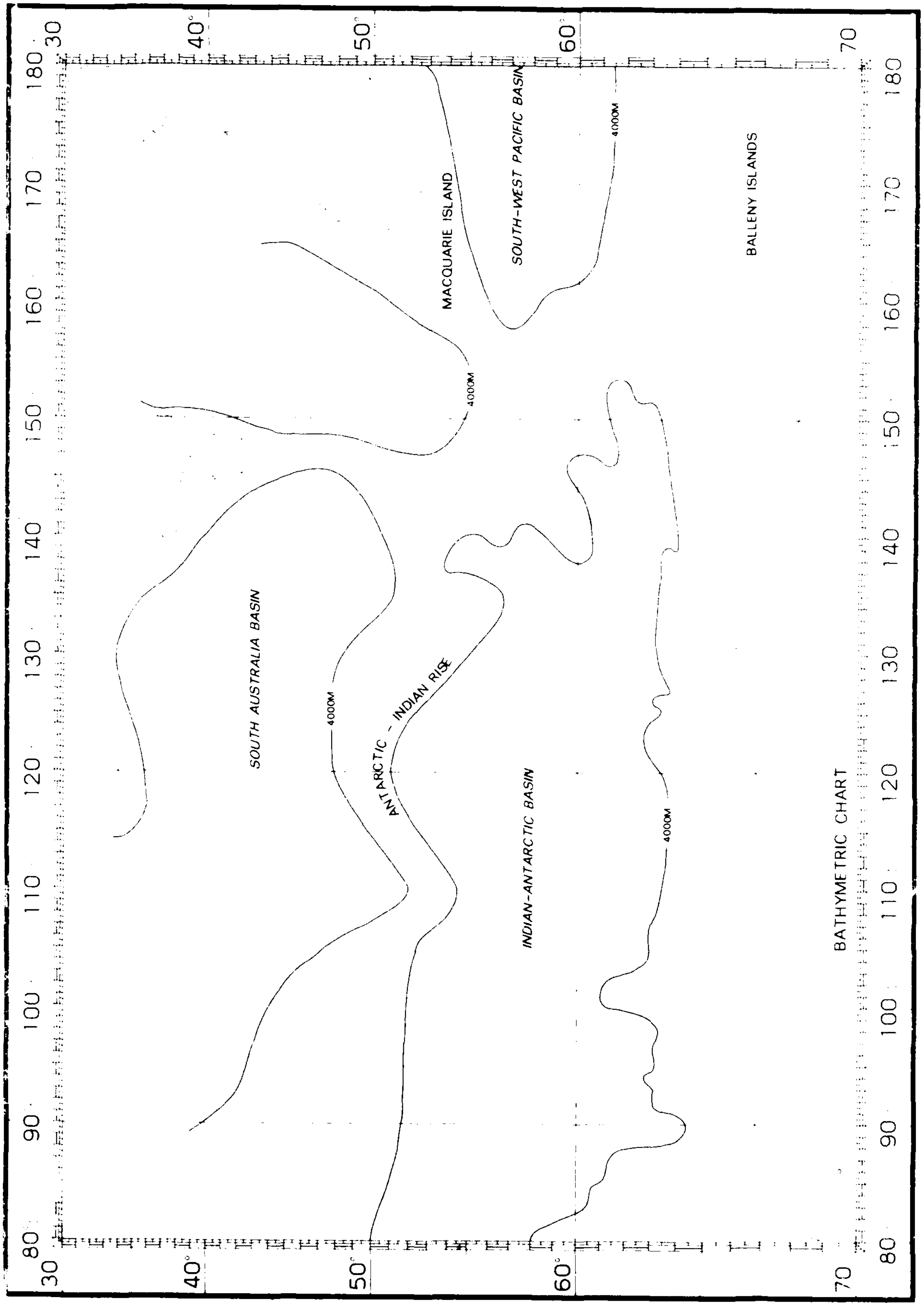


FIG 1 MAXIMUM WAVE HEIGHT AND AVERAGE PERIOD FOR WINTER



MAXIMUM WAVE HEIGHT AND AVERAGE PERIOD FOR SUMMER


BATHYMETRIC CHART
SOUTH AUSTRALIA BASIN
ANTARCTIC - INDIAN RISE
INDIAN-ANTARCTIC BASIN
MACQUARIE ISLAND
SOUTH-WEST PACIFIC BASIN
BALLENY ISLANDS
4000M
4000M
4000M
4000M
30
40°
50°
60°
70
80
90
100
110
120
130
140
150
160
170
180

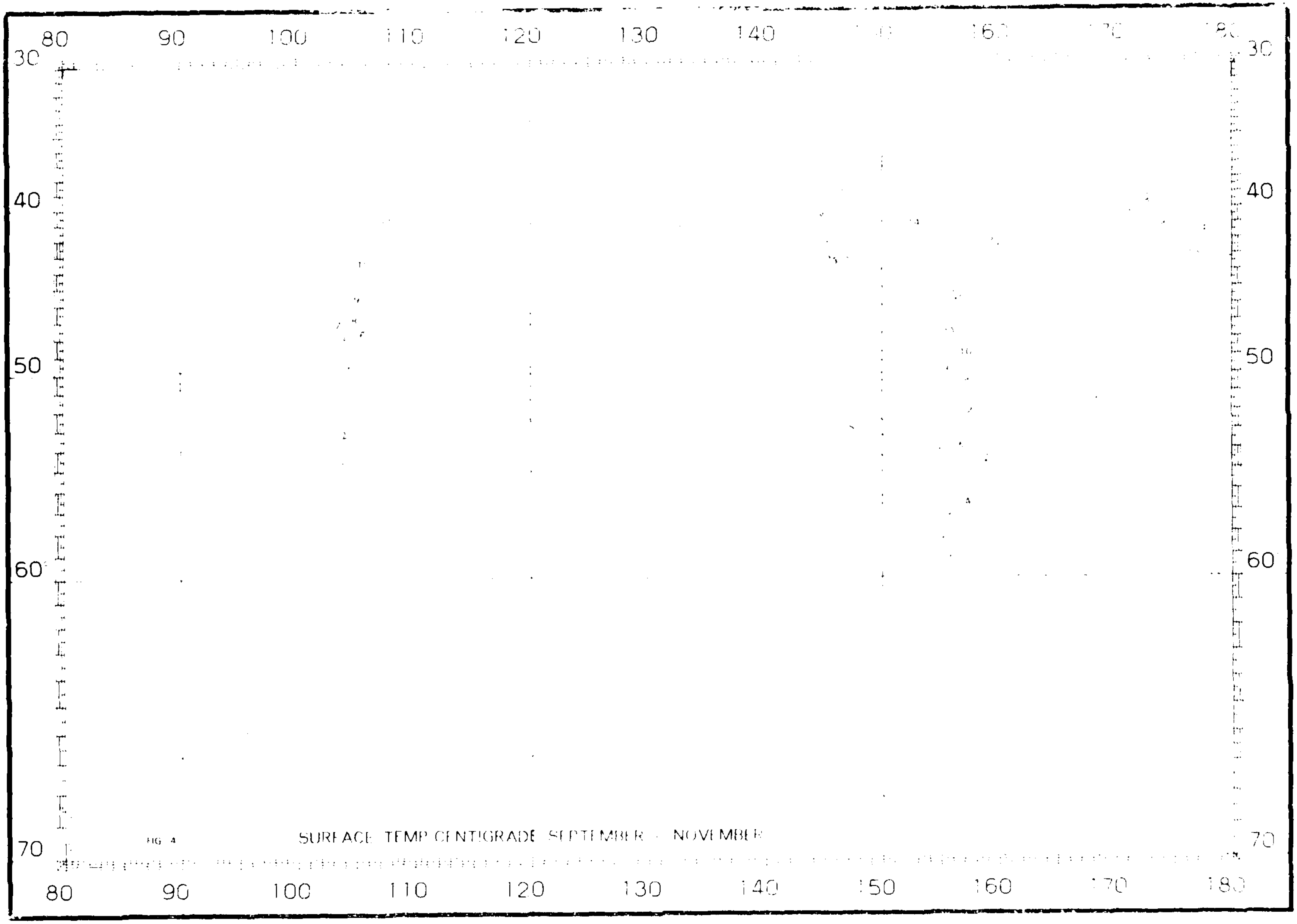
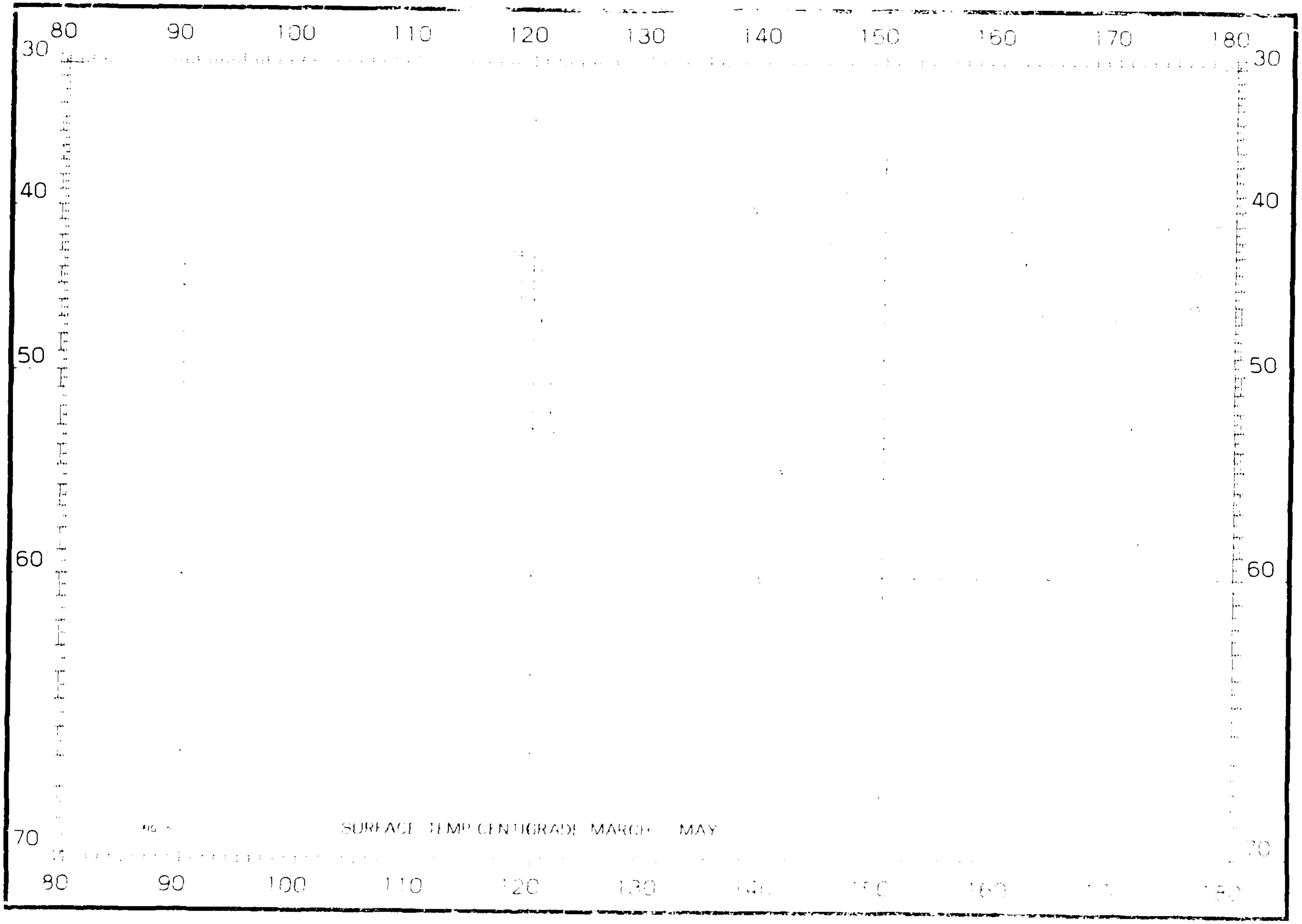
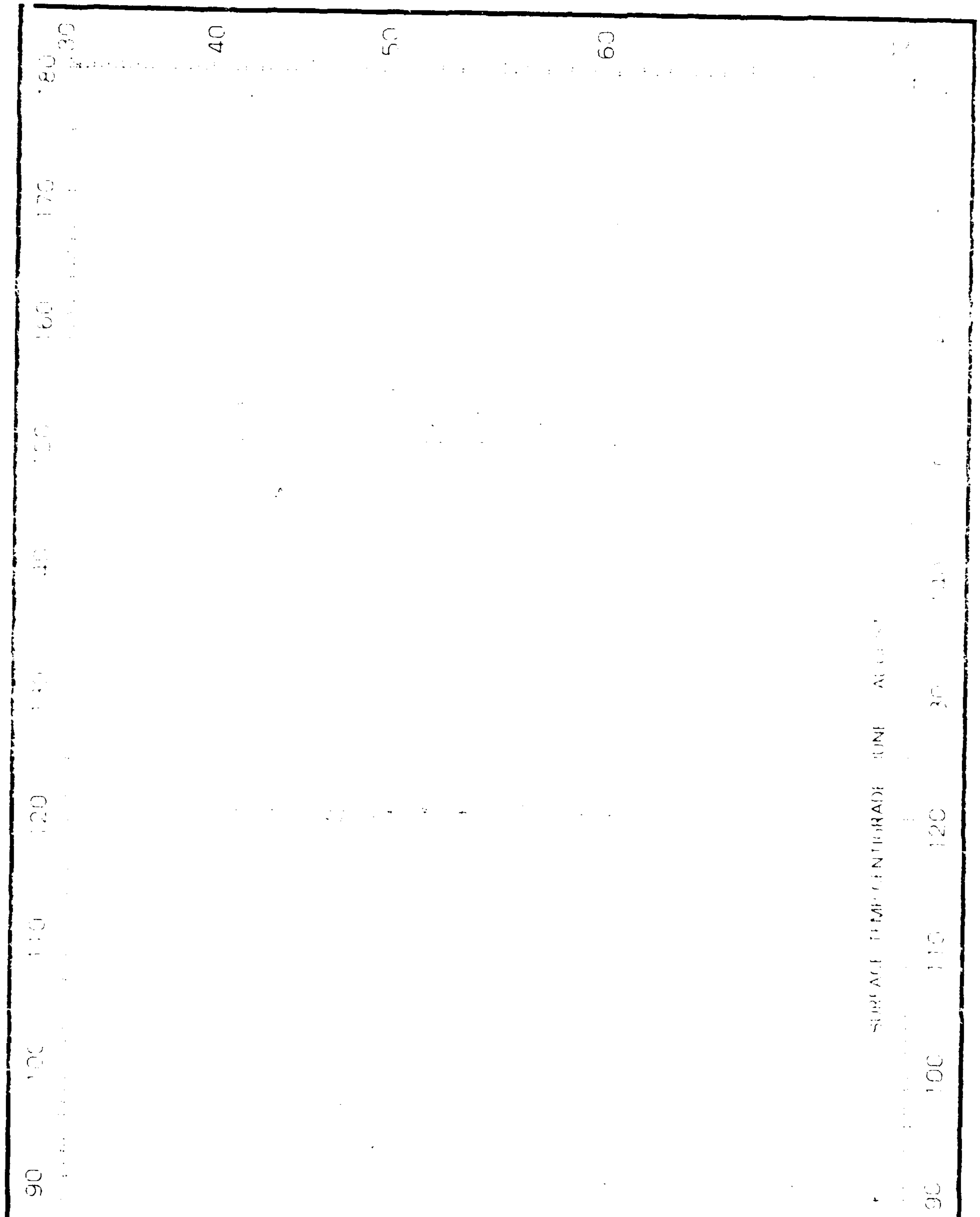


FIG. 4 SURFACE TEMP CENTIGRADE SEPTEMBER - NOVEMBER


SURFACE TEMP CENTIGRADE MARCH MAY
80
90
100
110
120
130
140
150
160
170
180
30
40
50
60
70



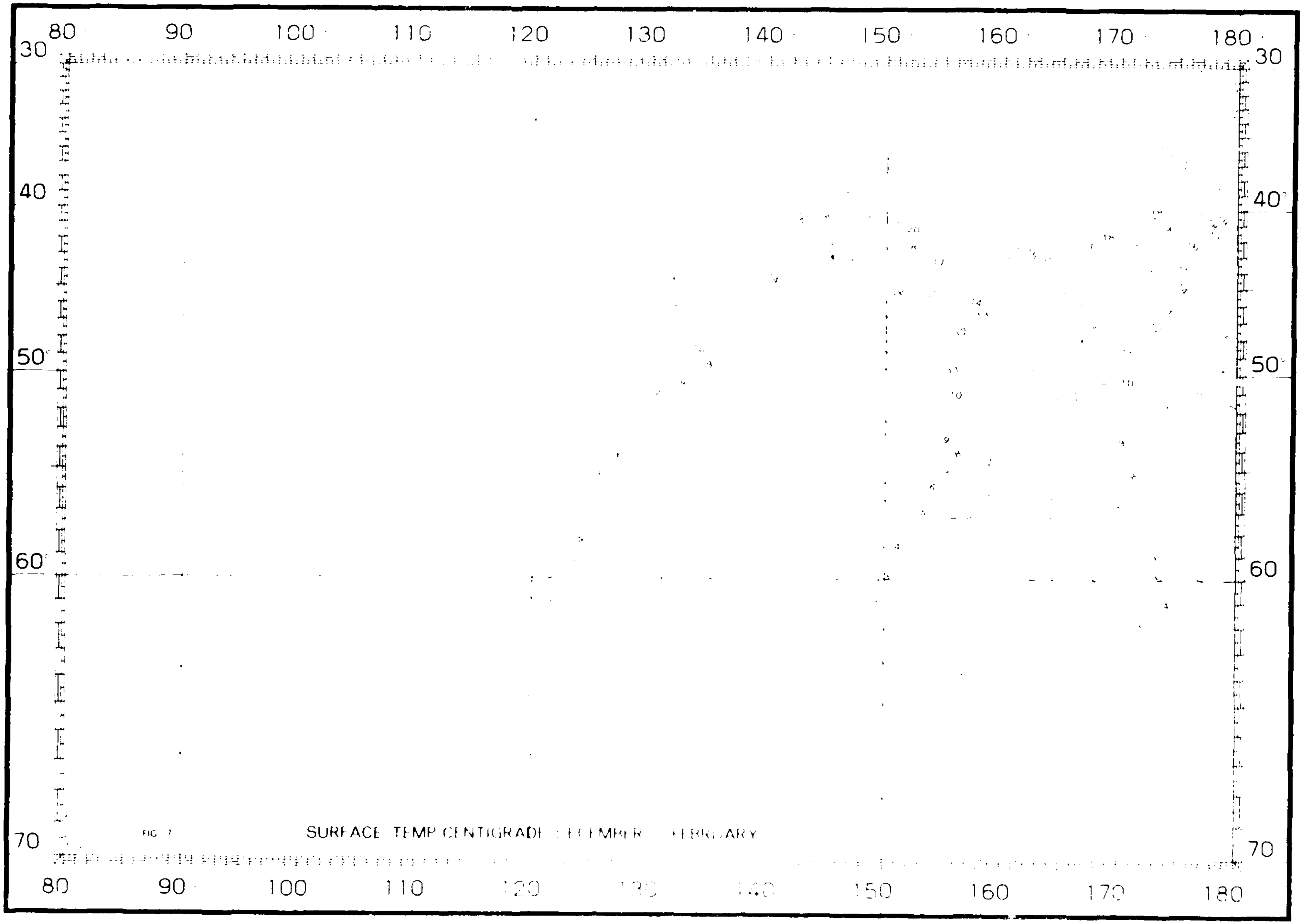


FIG. 7 SURFACE TEMP CENTIGRADE DECEMBER – FEBRUARY

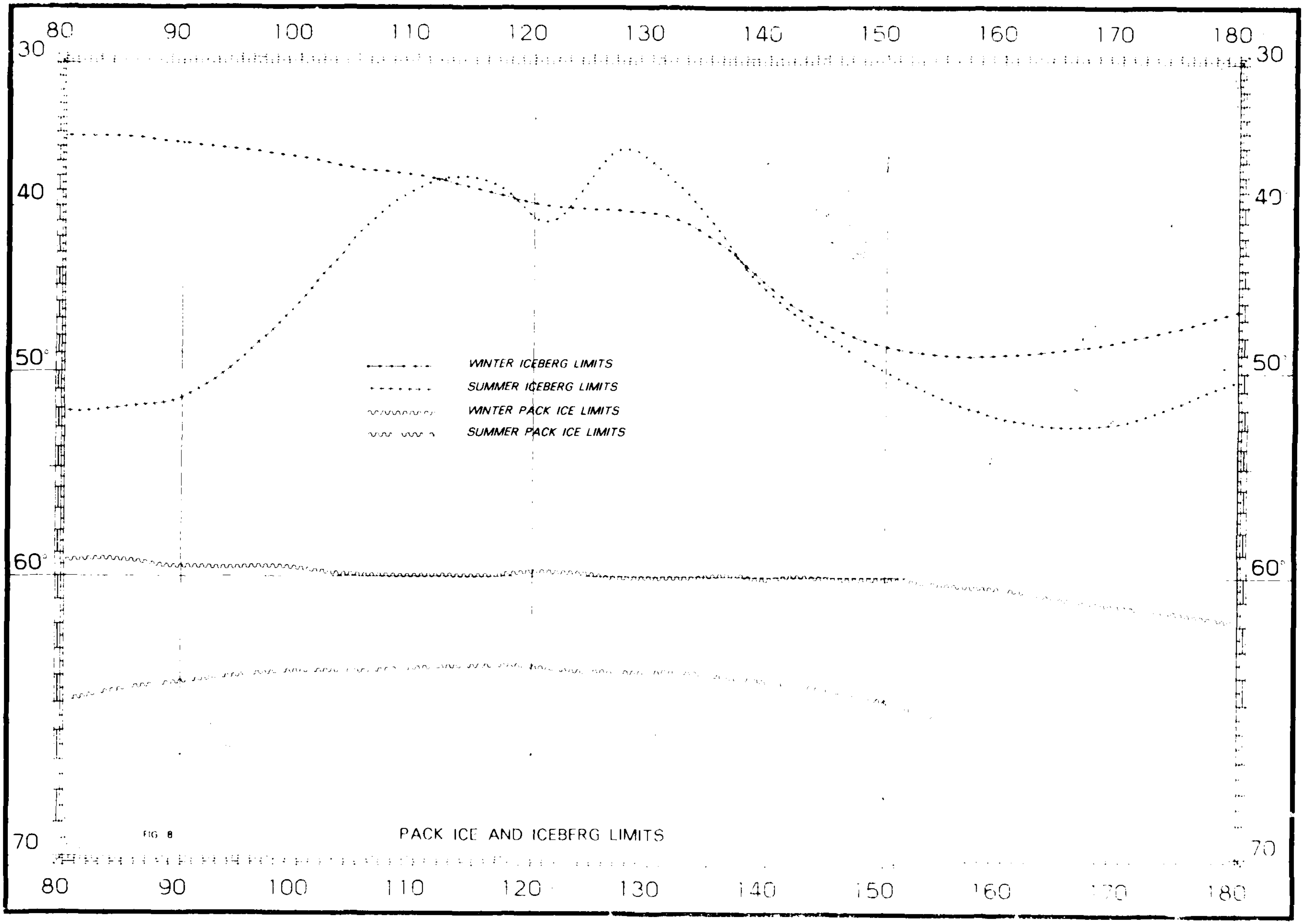
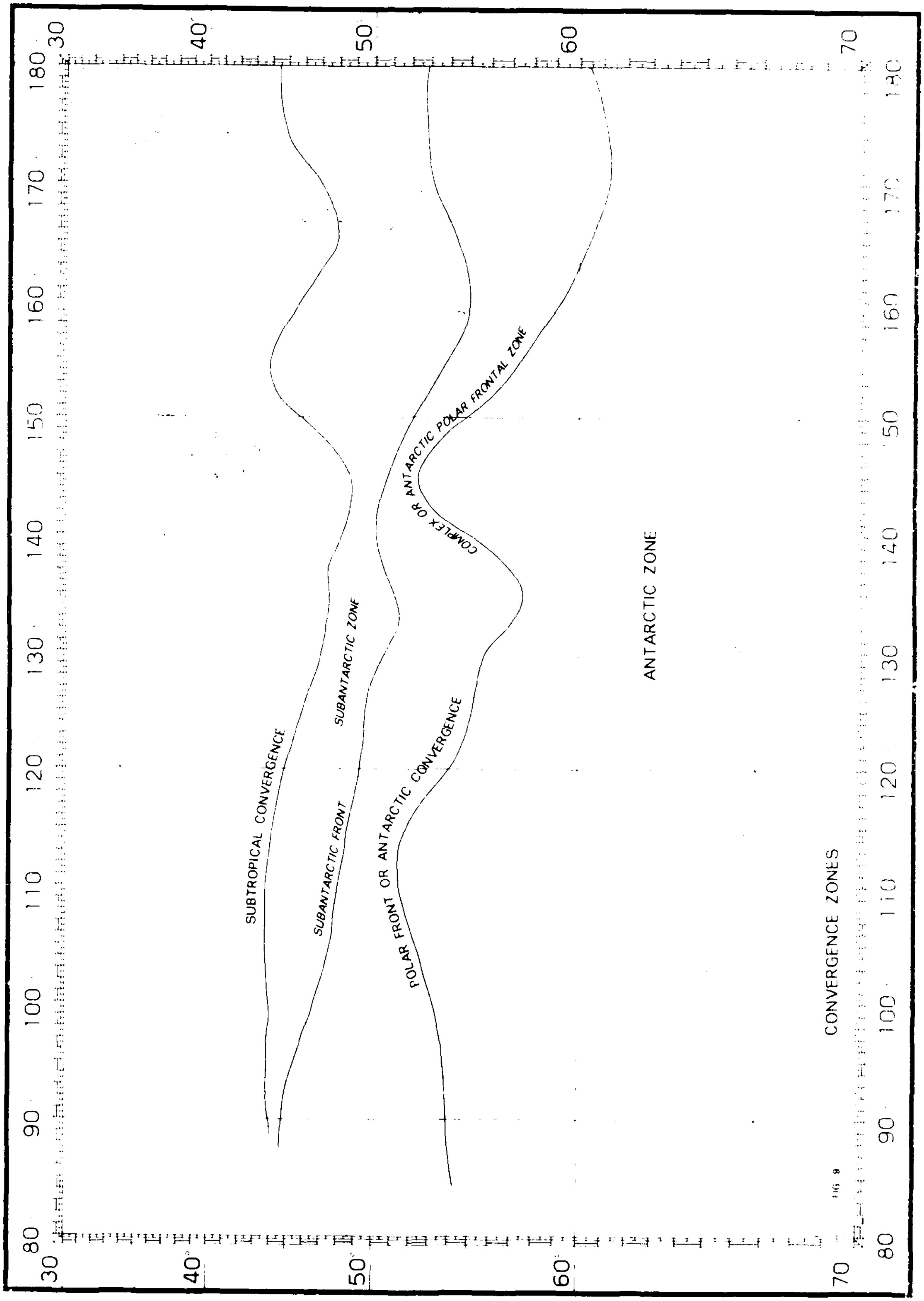


FIG 8

PACK ICE AND ICEBERG LIMITS


SUBTROPICAL CONVERGENCE
SUBANTARCTIC ZONE
SUBANTARCTIC FRONT
POLAR FRONT OR ANTARCTIC CONVERGENCE
COMPLEX OR ANTARCTIC POLAR FRONTAL ZONE
ANTARCTIC ZONE
CONVERGENCE ZONES
80
90
100
110
120
130
140
150
160
170
180
30
40
50
60
70

ANNEX A

ICE

Formation of Ice

1. Several forms of ice are encountered at sea. By far the most common type is that which results from the freezing of the sea surface, namely sea ice.

2. The freezing of fresh and salt water does not occur in the same manner. This is due to the presence of dissolved salts in sea water. The importance of salinity lies not only in its direct effect in lowering the freezing temperature but also in its effect on the density of the water. As the surface water cools it becomes more dense and sinks, and is replaced by convection by warmer, less dense water from below.

3. Fresh water reaches its maximum density at 4°C and further cooling reduces its density. Thus convection ceases when the body of water reaches 4°C and further cooling leads to a rapid drop in the temperature of the surface water and the formation of ice.

4. Salt water's density increases with cooling until it freezes. Hence the delay due to convection in the lowering of the temperature of the water to its freezing point is much more prolonged.

5. The Antarctic Sea ice usually reaches its maximum extent in late September and early October when its northern limit, South of Australia is about 59°S. The width of the ice belt is over 300nm in longitude at this time. Almost all of this ice is pack ice drifting under the influence of wind and current but a small proportion is fast to the coast.

6. The fast ice belt is discontinuous and relatively narrow. The outer limit approximates to the position of the 300m depth contour within which vast numbers of icebergs ground, thus forming anchoring points for the sea ice to become fast. The fast ice zone is up to 60 miles wide.

7. **Polynias** (open areas within the ice field) occur throughout the winter at the outer limit of the fast ice. They may be several hundred square miles in extent and are caused by the action of the off-shore winds which prevail around the coasts of Antarctia. These off-shore winds are sometimes interrupted by northerly winds associated with depressions. The northerly winds will close existing polynias.

Break-up of Sea-Ice

8. When warming begins in Spring the polynias extend to the north due to the action of the off-shore winds and the warming of the open water. Meanwhile melting is occurring at the outer edge of the pack ice as sea and air temperatures rise. Thus the sea ice breaks up from both the north and the south. Most parts of the coast in this sector remain affected by sea ice throughout the summer.

Icebergs

9. The Antarctic continent is covered by an icecap which is up to 3000m thick and accounts for more than 90% of the Earth's permanent ice. The ice constituting the ice cap is constantly moving outward towards the coast where many thousands of icebergs are calved each year from glaciers and ice shelves which reach out over the sea. As a consequence large numbers of icebergs are to be found in a wide belt which completely surrounds the continent.

10. **Tabular Icebergs** are the most common form and are the typical berg of the Antarctic, to which there is no parallel in the Arctic. These bergs are largely derived from ice-shelves. They are flat-topped and rectangular in shape, with a peculiar white colour and lustre, as if formed of plaster of paris due to their relatively large air content. They may be of great size; such bergs, exceeding one mile in length occur in hundreds, many have been measured over 20 miles in length. Their height above water generally varies between 10 and 35m.

11. The largest concentrations of icebergs are to be found close to their sources. Because of their draught many become grounded. Beyond the continental shelf there is a sharp decrease in the iceberg concentration though still many thousands are found in the deep ocean.

ANNEX B

ICE ACCUMULATION ON SHIPS

1 In certain weather conditions ice formed of sea water or fresh water accumulating on the hulls and superstructures of ships can be a serious danger.

2 Ice accumulation may occur from three causes:

(a) Fog, including fog formed by evaporation from a relatively warm sea surface, combined with freezing conditions.

(b) Freezing drizzle, rain or wet snow.

(c) Sea spray or sea water breaking over the ship when the air temperature is below the freezing point of sea water (about −2°C).

3 The weight of ice which can accumulate from causes (a) and (b) may increase on the rigging to such an extent that it is liable to fall and endanger those on deck. It is, however, small in comparison with the weight of ice accumulating in rough weather with low temperatures, when large amounts of spray, and often heavy seas, break over a vessel. Radio and radar failures due to ice on aerials or insulators may be experienced soon after ice starts to accumulate.

4 When the air temperature is below the freezing point of sea water and the ship is in heavy seas, considerable amounts of water will freeze on to the superstructure and those parts of the hull which are sufficiently above the waterline to escape being frequently washed by the sea. The amounts so frozen to surfaces exposed to the air will rapidly increase with falling air and sea temmperatures, and might in extreme cases lead to the capsizing of the vessel.

4. The dangerous conditions are those in which strong winds are experienced in combination with air temperatures of about −2°C or below; freezing rain or snowfall increases the hazard. The rapidity with which ice accumulates increases progressively as the wind increases above force 6 and as the air temperature falls further below about −2°C. It also increases with decreasing sea temperatures. The rate of accumulation also depends on other factors such as the ship's speed and course relative to wind and waves, as these affect the amount of spray produced.

6 Probable percentage frequency of heavy to severe superstructure icing in the Australian sector, based on the probable simultaneous occurrence of gale force winds and air temperature below −2°C, is 5% at 60°S in summer. In winter probability of 5% occurs at about 55°S increasing to 10% at 60°S.

ANNEX C

MIRAGE

1. Rays of light passing through the atmosphere are subject to a certain amount of bending due to the varying refractive power of air of varying density. Objects below the horizon sometimes become visible e.g. lights may be "raised" at night at much greater distances than one would ordinarily expect. In abnormal conditions, refraction accounts for the phenomena of mirage.

2. **Inferior Mirage**. Mirages are of two kinds. Inferior mirage occurs when air near the ground is much hotter and thus less dense than that immediately above; a common phenomena by day over a heated desert or smooth road on calm hot days.

3. **Superior mirage** occurs when there is a marked inversion of temperature e.g. when the surface is cold (and wind light) and air above is relatively warm so that the density of the air decreases rapdily for a short distance above the surface, so that light rays are bent down. During fine weather in the Antarctic superior mirages occur fairly frequently. The image, usually inverted but sometimes erect appears above the object. Unlike in the case of inferior mirage, the stratification which produces superior mirage is stable and the image clear and well defined. Moreover, the distances are great so that details can hardly be observed without telescopic aid.

4. Reports of coastal mountains at distances of hundreds of miles appearing to be on the near horizon are not uncommon.

5. **Anomalous radar** does not necessarily occur when superior mirage occurs. However, the meteorological conditions required to produce superior mirage are most likely to occur under the influence of an anticyclone. Anticyclones produce subsidence inversions, which on reaching low levels create the conditions required to anomalous radar propagation. (The depth of duct required for abnormal propagation increases with wavelength, being about 50 feet for a wavelength of 3cm and about 600 feet for a 1 metre wavelength).

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THE MARINE STUDIES CENTRE

The Marine Studies Centre at the University of Sydney serves two purposes: it co-ordinates the undergraduate teaching for the marine sciences degree and it encourages graduate research. Undergraduates who wish to take a degree in marine sciences study the usual sciences subjects in first and second year. There is a second year course entitled Introductory Marine Sciences and this serves as an introduction to both the physical and life sciences. In third year students usually specialise in either the physical sciences or in marine biology. For instance students wishing to become physical oceanographers would study third year mathematics and courses in coastal processes, waves and physical oceanography.

Research training in marine sciences is varied. Many students in the life sciences study the distribution and abundance of marine animals at the University's tropical field station – One Tree Island (23°30'S, 152°5'E). This island which has been set aside for research is continuously monitored by biologists. Other studies involve the reproduction of Australian marine invertebrates and the ecology of intertidal animals of the N.S.W. coast.

Physical oceanographic research involves studies of Australian beaches and the manner in which they respond to the waves. Wave climate is important in both sand movement on the beaches and in the design of harbours and breakwaters. Such statistics are being prepared for the east coast. Moving into deeper water, work is being carried out to determine the nature and movement of the sediments on the continental shelf. Wind and tides drive the currents over the shelf while the summer heating produces a hotter upper layer. The deep ocean tide often excites large waves on this interface between the lighter upper layer and the colder bottom waters and such waves can propagate across the shelf and may break as the water shallows. Investigations are underway to see if such waves can induce large bottom currents and sediment movements.

As one moves off the continental shelf marine geologists are interested in the physiography of the slope. As the continents moved apart they left steep slopes that influence current motions and the propagation of sound.

The deep ocean basins between the continents contain the major ocean currents and these influence our climate. Satellites are a good tool for studying such global scale phenomena and a number of attempts to map these features are underway using existing satellites.

Finally the Marine Studies Centre carries out laboratory work. Part of this involves calibrating and determining the response of both conventional and novel current meters. Other laboratory models simulate internal waves and mixing in the oceans. It is easier to isolate effects in controlled situations and then to look for their impact in the more complex ocean.

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MONITORING OF HIGH FREQUENCY CURRENTS ON THE INNER CONTINENTAL SHELF OF N.S.W.

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Sydney NSW
Australia 2060

Introduction

The N.S.W. Public Works Department is presently investigating seabed sediment movement in the nearshore zone as part of its studies of beach dynamics. Long term beach erosion has recently been identified on many sections of the N.S.W. coastline with major development and recreational facilities being threatened. The Department is investigating longshore and onshore/offshore sediment transport patterns in the highly active surf zone and in the lower energy zone between the 10m and 50m depth contours. A programme of research is also being undertaken into the potential impacts on the coastline of offshore coastal engineering works such as sand extraction and construction of sewage diffusers on the seabed.

The study involves a number of aspects, including:

- monitoring of near-bed currents;
- monitoring of wave climate;
- observation of sediment dynamics by divers and remote time-lapse photography.
- sand tracing
- monitoring of subaqueous beach profiles via diving observations at permanent bottom stakes,
- monitoring of subaerial beach profiles by aerial photography,
- mapping of seabed topography, bedforms and sediment distribution by echo sounder, sonargraph, diving and sampling.

Metering of currents is the prime oceanographic aspect of the programme and is outlined in more detail below.

Current Spectrum

A complex structure of currents exists in the area of interest, with the following phenomena superimposed:

- gravity wave oscillatory flows;
- ocean currents;
- tidal currents and river flows;
- wind and wave induced quasi-steady currents

The first component, which is due to surface wind waves, causes high frequency orbital flows with a period range of two to fourteen seconds. These currents act as a stirring process, entraining bottom sediment which may then be transported by any residual "steady" current (Figure 1)

In terms of this mechanism of sediment transport, the remaining components vary relatively slowly and are either stochastic (e.g. ocean currents) or low frequency periodic (e.g. the 12 4 hour tidal cycle)

Instrumentation

The significance of the short period oscillatory flows in the transport process requires that the metering instruments have high frequency response characteristics. Propellor and vane type meters such as Anderas are unsuitable in these relatively shallow depths.

Electro-magnetic meters developed by Marsh McBirney Inc. of the U.S. were found to be suitable for this application. The instruments have a solid state spherical sensor which measures "instantaneous" X and Y components of flow (Photo 1). A compass in the pressure case records orientation of the orthogonals relative to magnetic north. The instruments are fully remote, logging on magnetic cassettes

The data system is microprocessor controlled, recording:

- internal calibration and status parameters,
- day/hours/minutes;
- either vector averaged or raw data (normally at one second intervals,
- either continuous or burst samples (e.g. a ten minute record each four hours)

A data interface in the instrument allows flexible system initialisation and checking in the field as part of the regular casssette and battery renewal procedure.

The Department has had two instruments deployed since November, 1979, in depths of 24m offshore from Broken Bay and Palm Beach, on the northern outskirts of Sydney. The meters are rigidly mounted in steel frames with the sensor located one metre above the bed. Photo 2 illustrates a meter and frame during deployment off Palm Beach in June 1981. The instruments are recovered by divers at six weekly intervals for battery and cassette replacement. The meters are periodically removed for calibration in the tow tank of the Sydney University Hydrodynamics Laboratory.

Data Analysis

The instruments have normally been programmed in a raw data, burst sampling mode (continuous one second data points for ten minutes followed by seven hours shut-down). A sample of raw data is plotted in Figure 1 and shows a 1m, 8 second swell producing typical peak instantaneous velocities of 15cm/s, superimposed on a steady current of 7cm/s flowing to the south-west (predominantly the flood tide into the Hawkesbury River estuary).

After data transfer from cassette to reel, data are analysed for statistical properties (e.g. burst mean, variance, exceedance and spectral properties) and certain values are correlated with relevant forcing functions (e.g. tide range and phase; wave height, period and direction; wind strength and direction). Future studies, utilising these current data, will include development of a sediment transport model.

Conclusions

Current data collected to this time have indicated that velocities are sufficiently high for a significant percentage of the year to cause medium grain sized sand at the two metering sites to be above the threshold of sediment transport. Instantaneous velocities of 15cm/s are exceeded approximately 14% of the time, with peak values of 150cm/s having been observed under storm waves. Vector averaged currents over a ten minute record are much lower, with a typical magnitude of 5cm/s and a distinct NE/WSW ebb/flood tidal pattern.

Acknowledgements

Various personnel from the Department have provided invaluable assistance to this programme, particularly Mr. T. Bolton with electronic advice and Messrs. P. Beckman and B. Sena with field work and diving operations. The author also wishes to thank Ms. F. Coffey of the Coastal Studies Unit, Geography Department, Sydney University for assistance with computer analysis and Mr. B. Halliday, Mechanical Engineering Department, Sydney University for use of the Hydrodynamics Laboratory tow tank.

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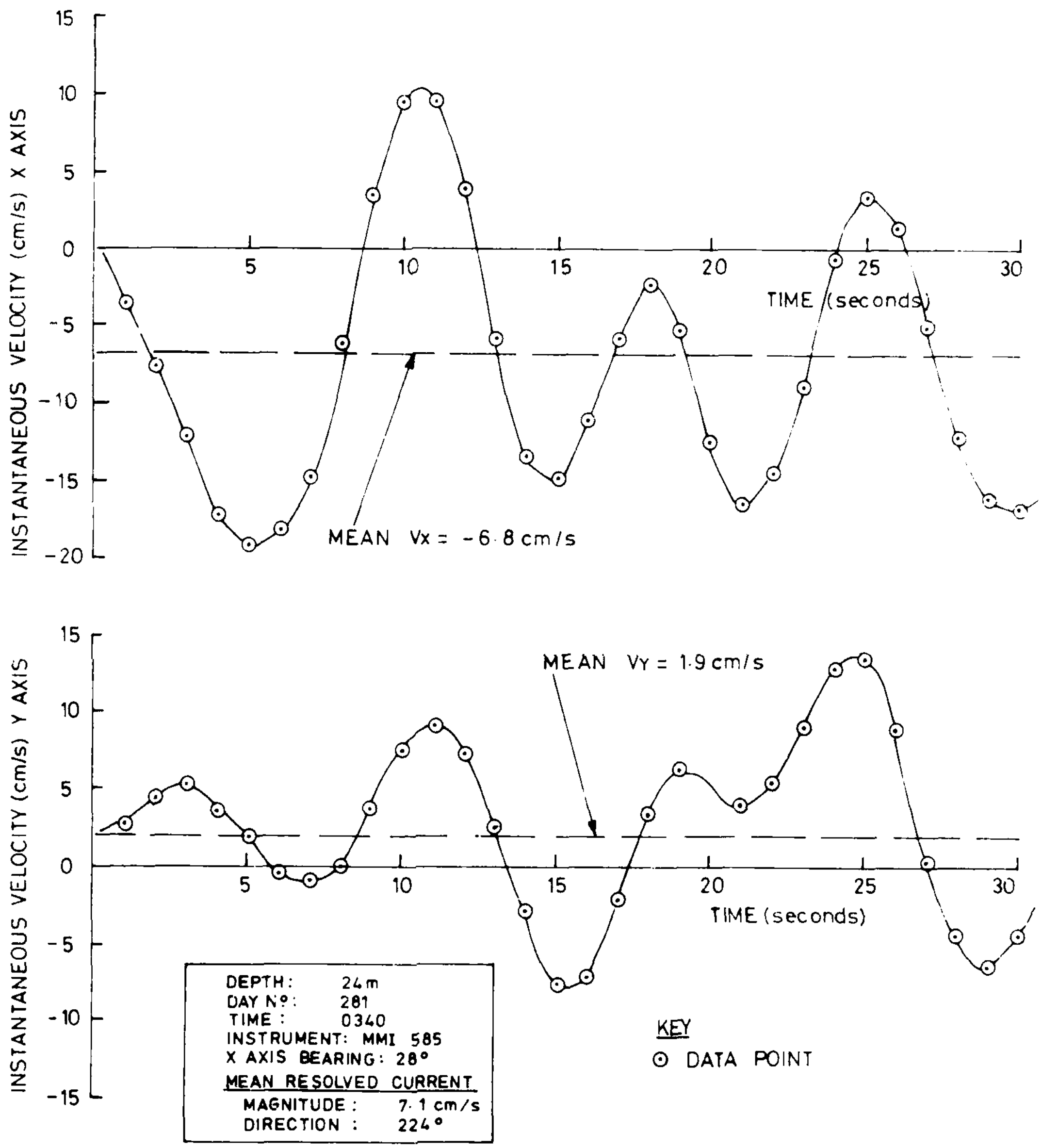
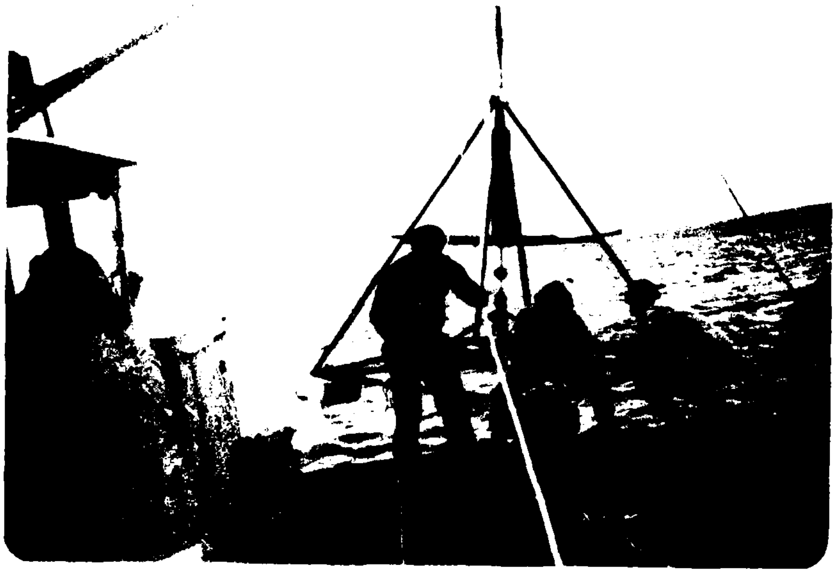


FIGURE 1 : SAMPLE OF RAW CURRENT DATA, BROKEN BAY - 7 OCTOBER, 1980

LEFT: Photo 1, Dual axis sensor of electro-magnetic current meter.

BELOW: Photo 2, Current meter and frame being deployed in 24m depth off Palm Beach - 19 6 81.



OCEAN SCIENCES INSTITUTE ANNOUNCED

The University of Sydney and the Defence Department have reached an agreement in principle to establish an Ocean Sciences Institute within the University of Sydney.

The purpose of the new arrangement is to foster fundamental research on the physical nature of the ocean and its floor. While both organisations will be supporting the continuance of the Institute, research contracts and grants will also be sought. The Ocean Sciences Institute will be located on the University of Sydney campus. The Institute will not be involved in any research of a classified nature.

Professor G M. Philip, Director of the Marine Studies Centre at the University of Sydney, said that "an Ocean Sciences" Institute would be of considerable benefit to both organisations. A group of research oceanographers on campus will strengthen our teaching program in physical and geological oceanography. In disciplines that involve complex field experiments, a considerable concentration of professional talent is needed and this is difficult to assemble within existing University resources. Defence science will benefit from being able to bring the talents of the University to bear on problems in the ocean sciences".

The University expects that a number of the existing faculty will be affilated with the Institute. **Associate Professor Packham** and **Dr. David Falvey** of the Department of Geology and Geophysics are already involved, thru the Defence Research Group, in oceanographic research from Navy vessels and they wish to carry out within the Institute a study of the nature, genesis and history of the seafloor around Australia.

The Institute will have access to the towing tank in the Department of Mechanical Engineering in order to evaluate oceanographic current meters. **Mr. R. Halliday** has carried out extensive research into the fluid mechanics of devices to measure currents and such studies are valuable if the Institute is to undertaken any field program that involves monitoring water movement.

"It is hoped" said Professor Philip, "that the Institute will stimulate increased activity in acoustics in the ocean and sea floor. The Department of Applied Mathematics has a long history in seismic studies and the increased activity of more physical oceanographers on compus [who are often trained initially as applied mathematicans] may lead to an increase of research in this area."

Physical oceanography is a major discipline in the study of the ocean and has been neglected within the University in the past. **Dr. Ian Jones,** an oceanographer at RANRL, and **Mr. Bruce Hamon,** both Honorary Associates of the University, have been developing a research program that involves coastal oceanography and satellite sensing of the ocean. The latter work is expected to become a central activity of the Institute. "It is hoped that a research fellow can be appointed promptly" says Bruce Hamon, "so that momentum can be maintained in the satellite work".

"Being a nation with such an extensive coastline, the development of an Ocean Sciences Institute should provide an important focus for research in the physical and geoscience aspects of marine science and promote the interaction between scientists from different disciplines", commented Gordon Packham.

WESTERN TASMAN OCEANOGRAPHIC ANALYSIS – NAS NOWRA

1. Since February 1981, charts of sea surface temperature, mixed layer depth and the 250m isotherm have been plotted and analysed by the Meteorological staff NAS NOWRA, the area of interest being enclosed by latitude 2944S to 3746S and by longitude 149E to 156E, which can be best described as the WESTERN TASMAN SEA. Initially the charts were prepared monthly, but are now being prepared on weekly basis. Examples of the three different charts are shown at Annex A

2. The sources of information which enable the charts to be plotted are

   a. Sea surface temperatures from surface ship observations and orbiting satellites (SATOB),

   b. Expendable bathythermograph data (XBT/AXBT), and

   c. Drifting current buoys

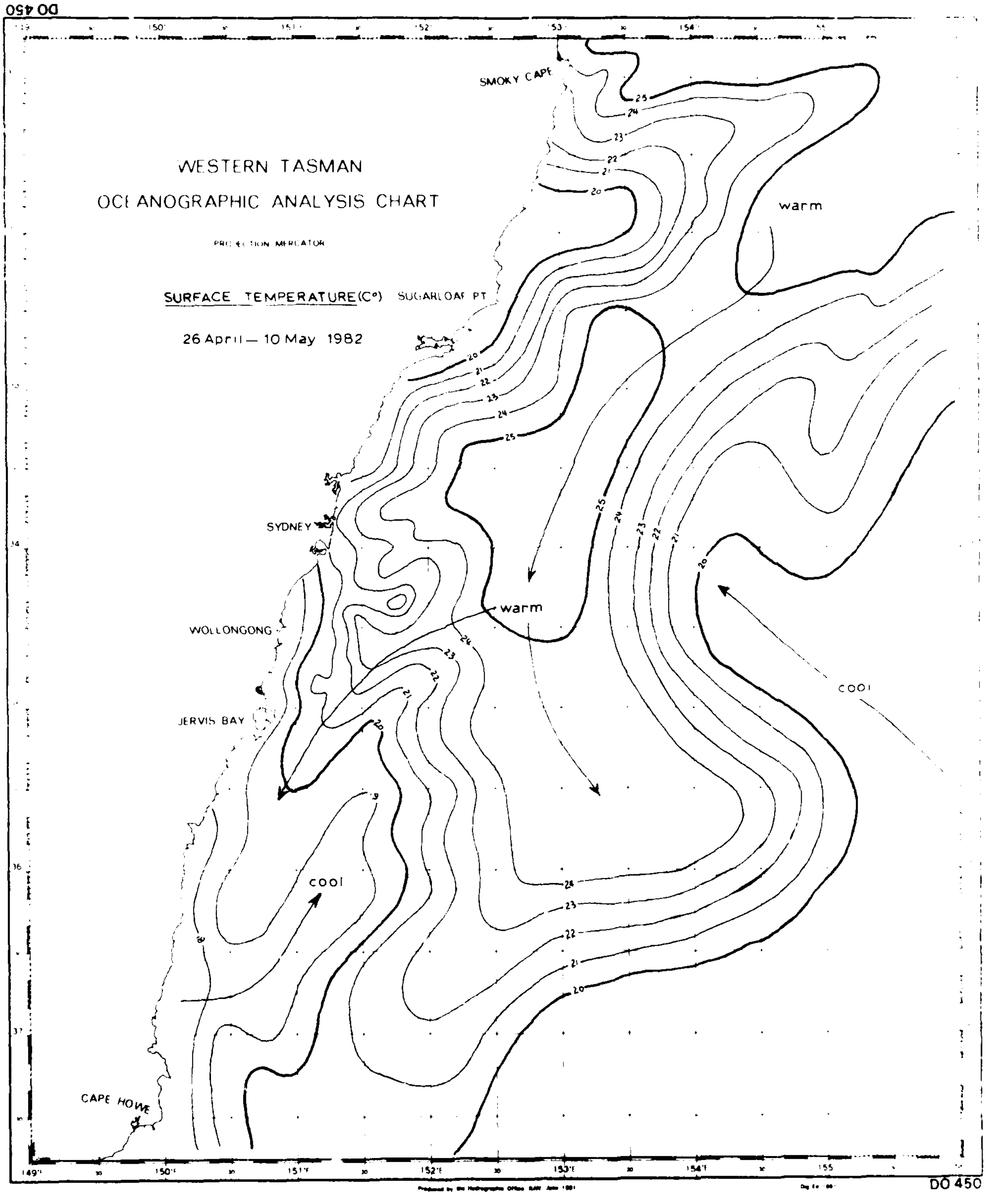
3. Once plotted the three charts are analysed, using as an aide infra red satellite imagery received from Macquarie University. On completion of the analysis, the two main water types found in the WESTERN TASMAN SEA can be located (TASMAN SEA and CORAL SEA water), and the mixing zone between the two determined (Tasman Front), which in turn enables the position and strength of the EAST AUSTRALIA CURRENT (EAC) to be found. The analysis also enables any major pools of warm water (eddies which tend to rotate counter-clockwise, to be located and a note kept of their weekly movement.

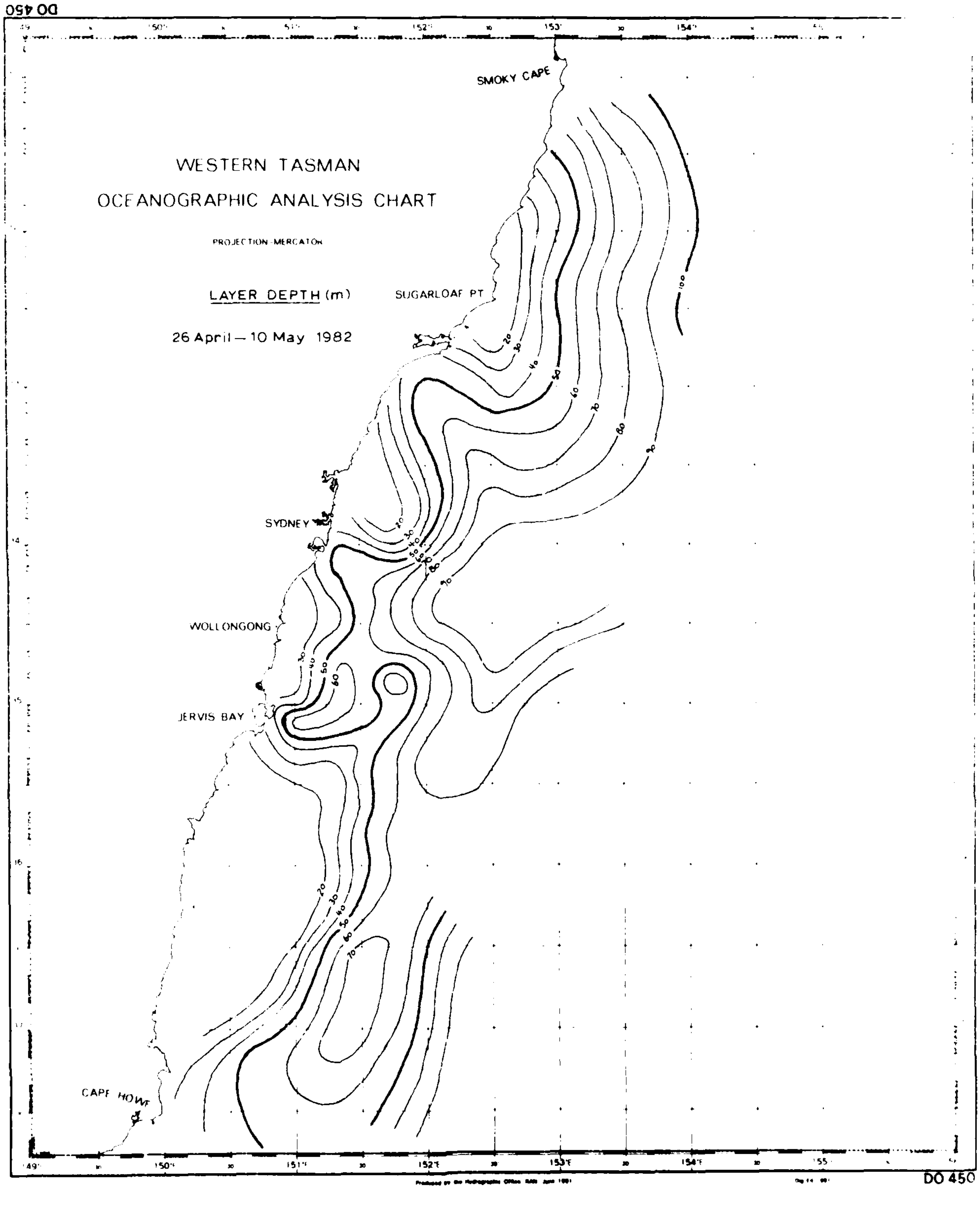
4. When completed, the three charts present a weekly picture of the vertical and horizontal structure of the WESTERN TASMAN SEA, and the changes from week to week can be readily observed. This three dimensional picture of the ocean structure can be used to determine optimum routing tracks for shipping, as well as for general oceanographic research.

Annex A   Examples of Oceanographic Charts produced by NAS NOWRA

These charts are now available from the Australian Oceanographic Data Centre. They are issued on a semi-regular (approx. every 10 days) basis. Further information can be obtained by writing to the A.O.D.C.:

Officer-in-Charge
A.O.D.C.
P.O. Box 1332
North Sydney 2060 N.S.W.
Australia.


DO 450
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
SURFACE TEMPERATURE(C°)
26 April — 10 May 1982
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
warm
warm
cool
cool
150°
151°
152°
153°
154°
155
149°E
150°E
151°E
152°E
153°E
154°E
DO 450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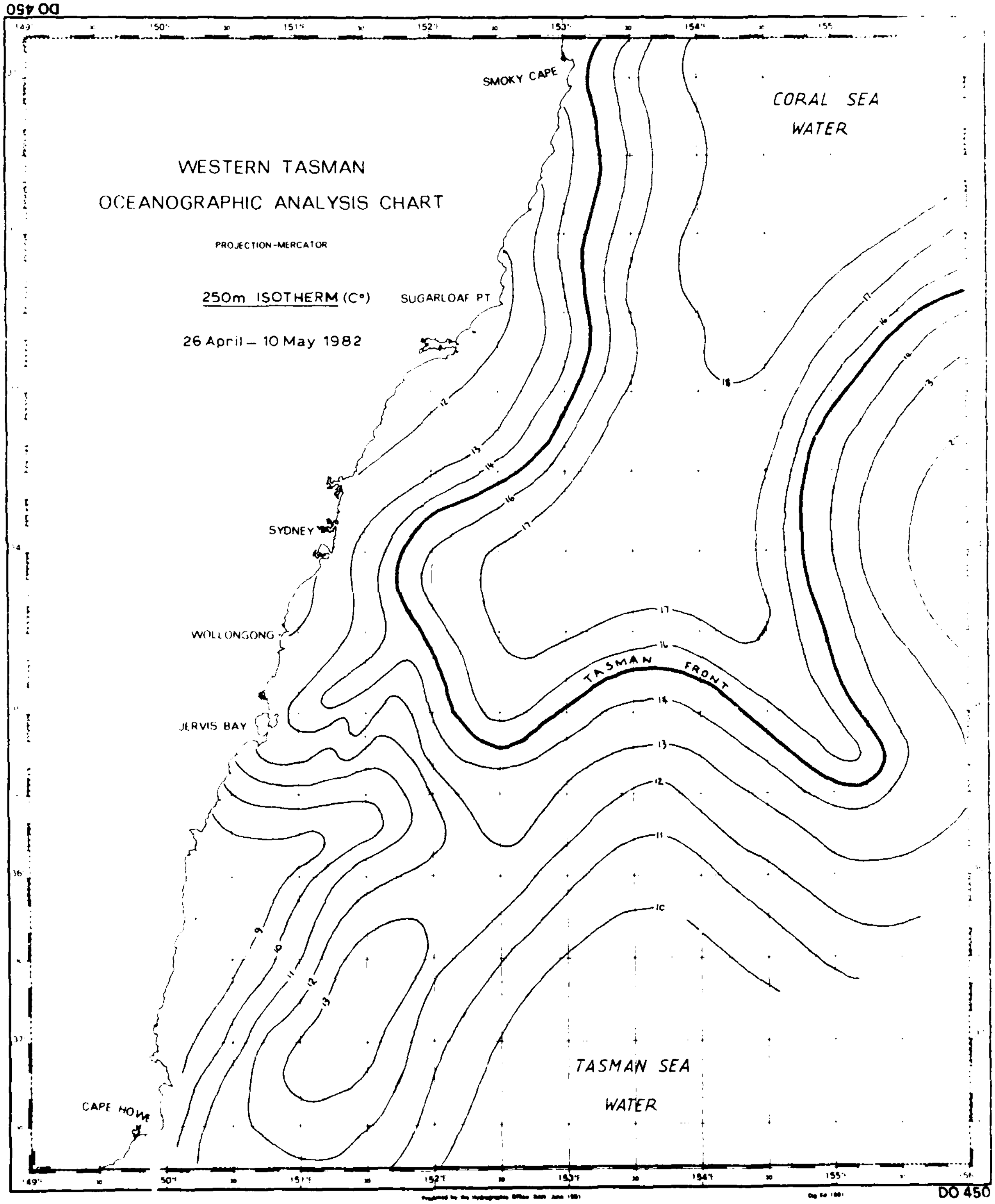
SMOKY CAPE
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION MERCATOR
LAYER DEPTH (m)
26 April — 10 May 1982
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
DO 450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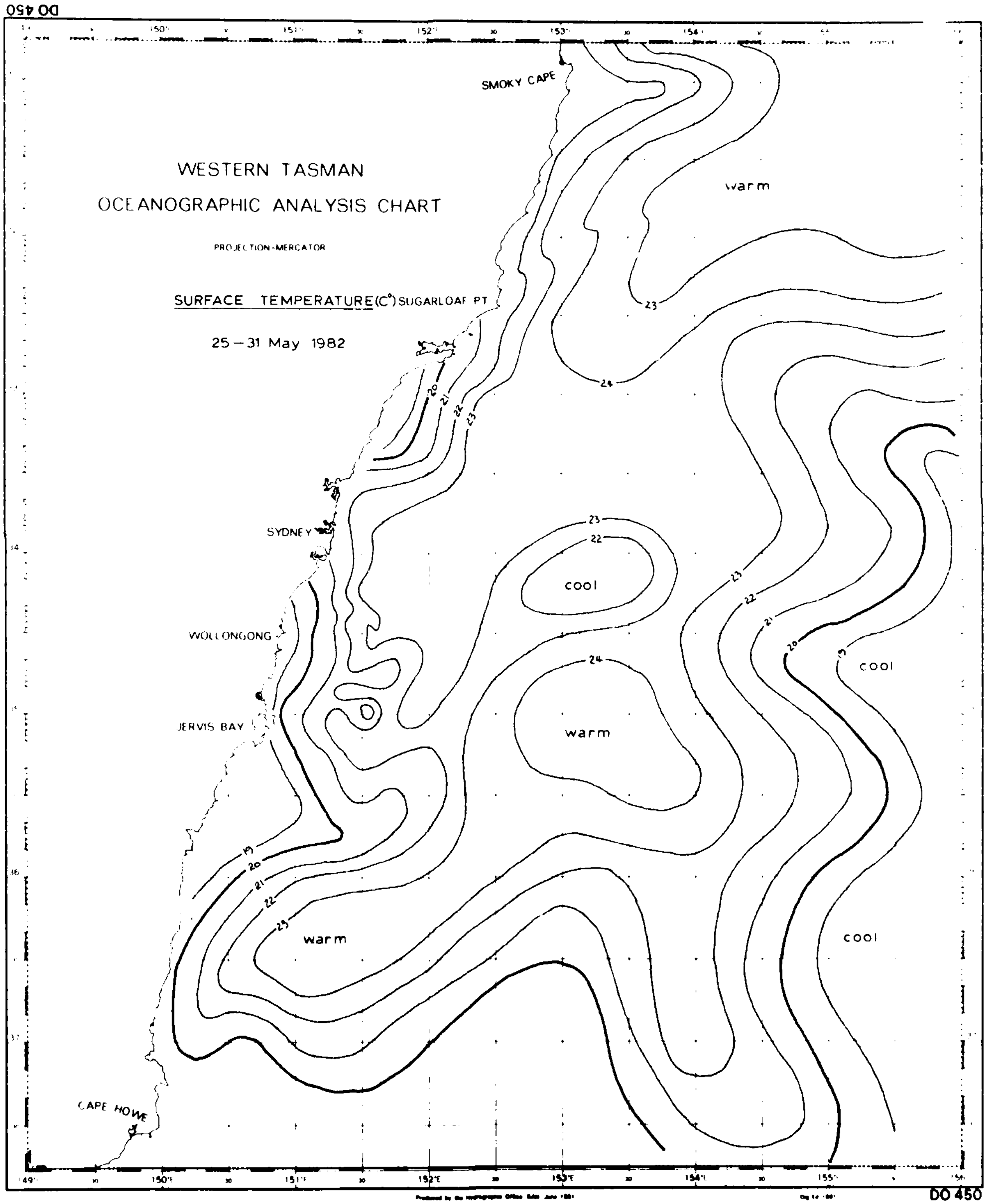
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
250m ISOTHERM (C°)
26 April – 10 May 1982
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
CORAL SEA
WATER
TASMAN FRONT
TASMAN SEA
WATER
DO 450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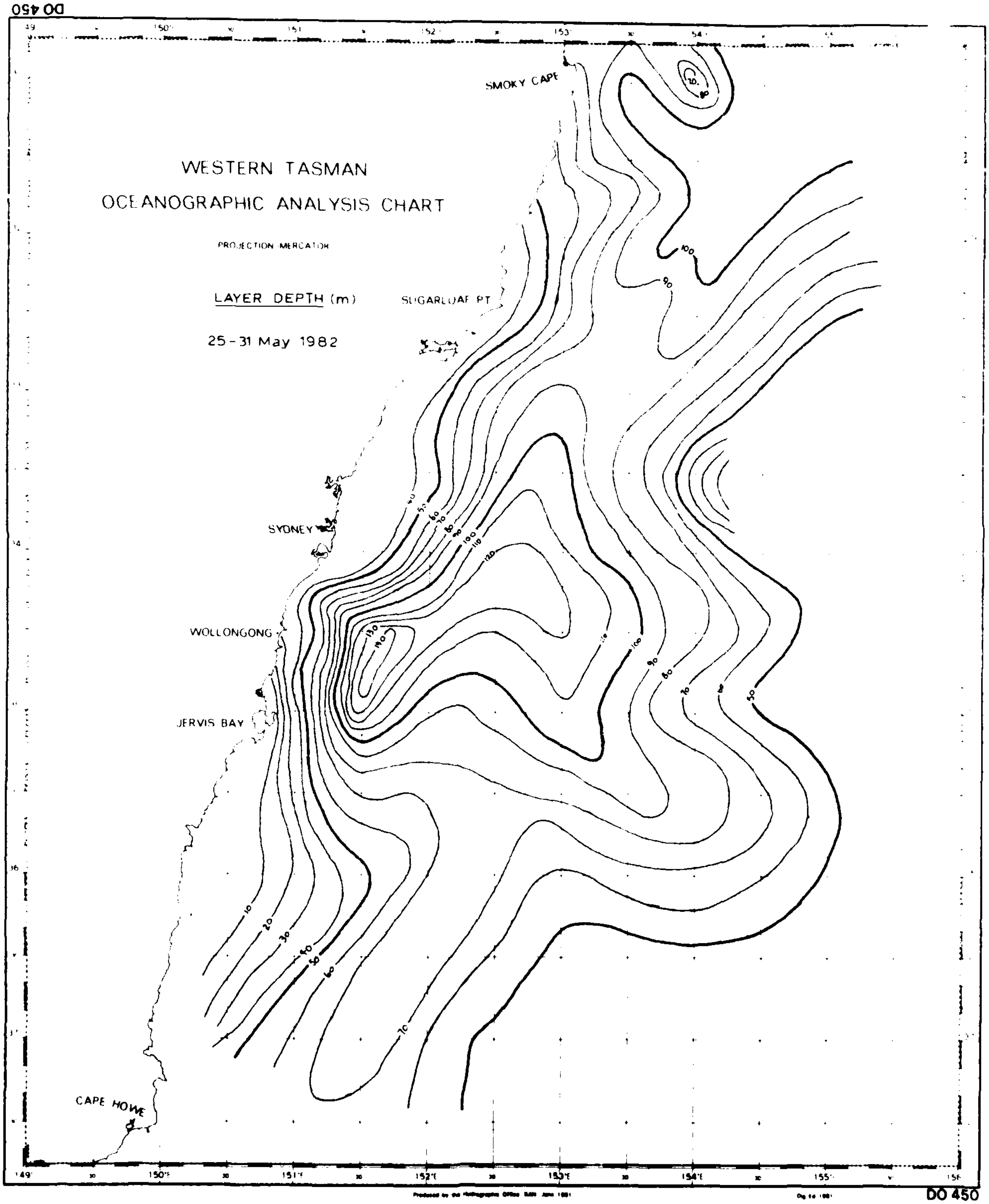
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
SURFACE TEMPERATURE(C°) SUGARLOAF PT
25 – 31 May 1982
SMOKY CAPE
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
warm
cool
150°E
151°E
152°E
153°E
154°E
155°
DO 450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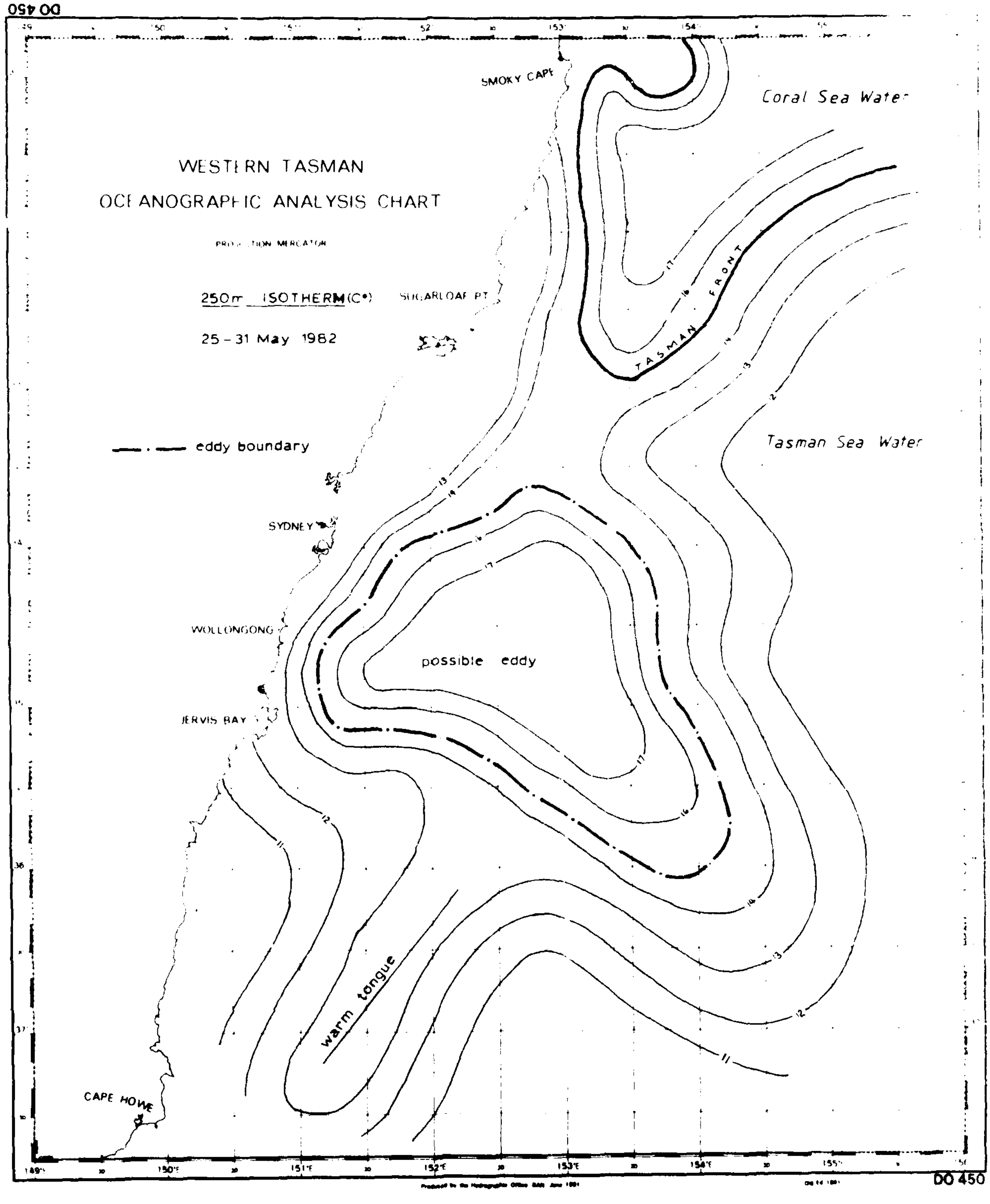
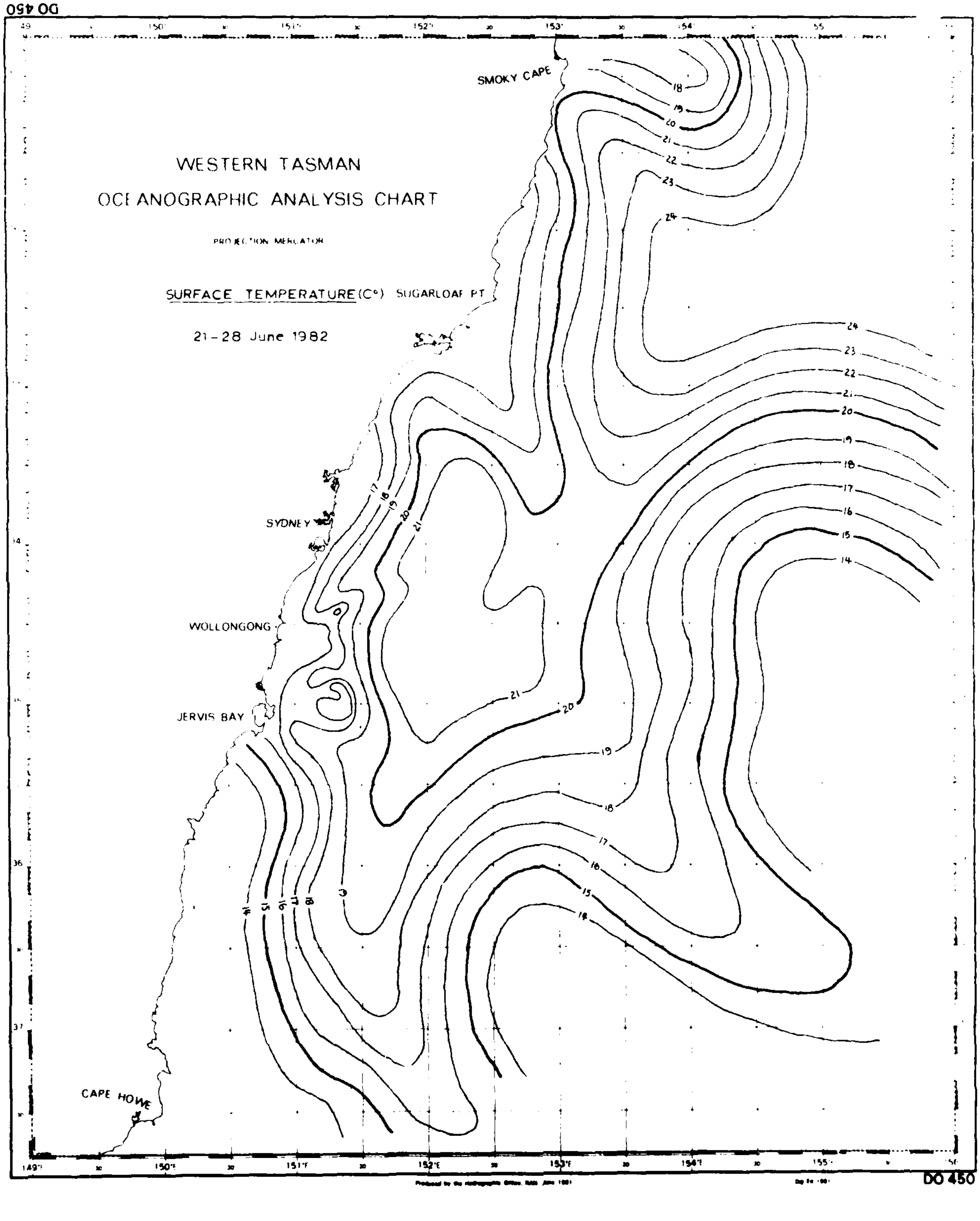
SMOKY CAPE
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION MERCATOR
LAYER DEPTH (m)
25-31 May 1982
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
149°
150°E
151°E
152°E
153°E
154°E
155°
DO 450


WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION MERCATOR
250m ISOTHERM(C°)
25 - 31 May 1982
eddy boundary
Coral Sea Water
Tasman Sea Water
TASMAN FRONT
possible eddy
warm tongue
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
DO 450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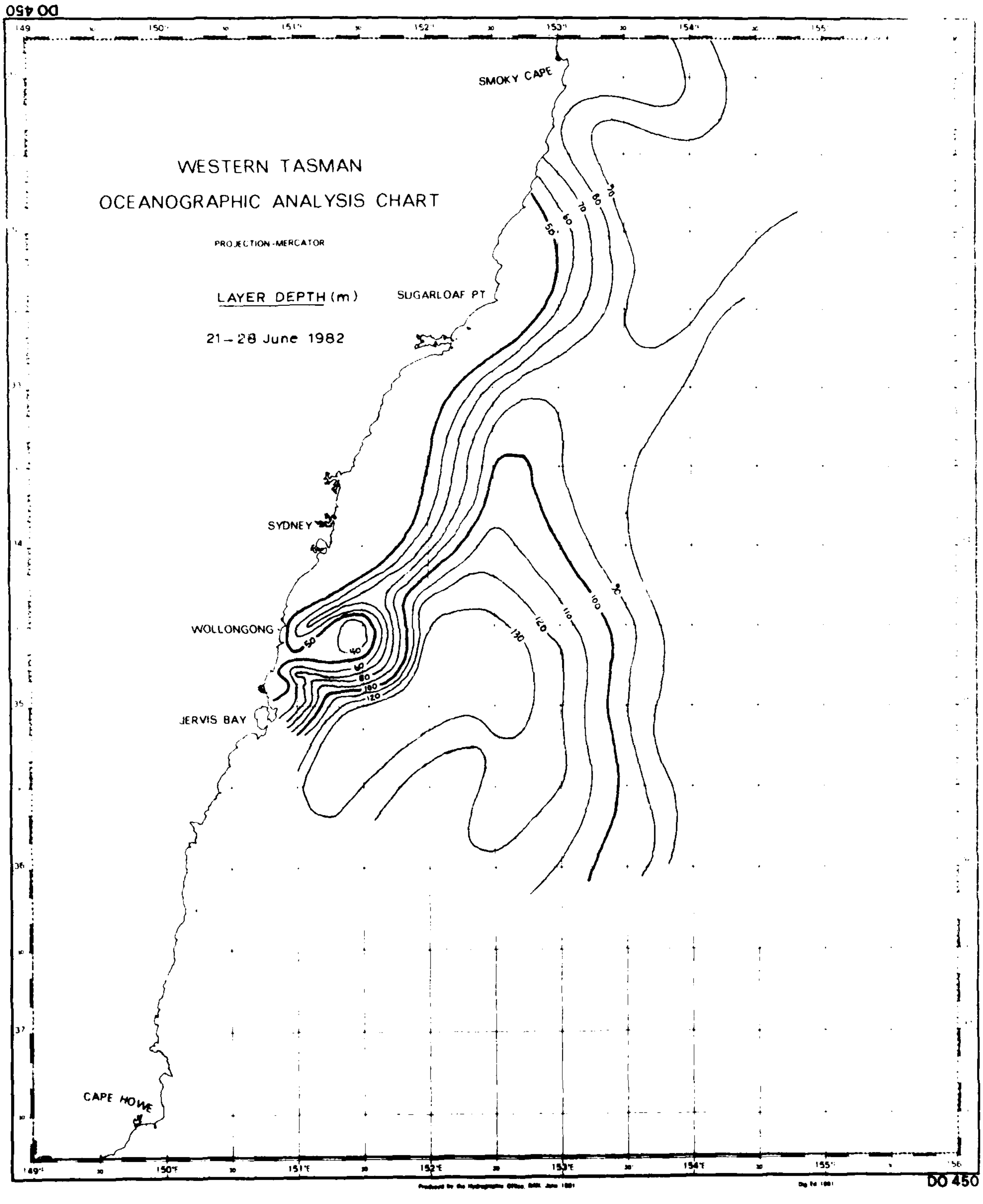
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION MERCATOR
SURFACE TEMPERATURE (C°)
21-28 June 1982
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
149°
150°
151°
152°
153°
154°
155°
36
37
14
15
16
17
18
19
20
21
22
23
24
DO 450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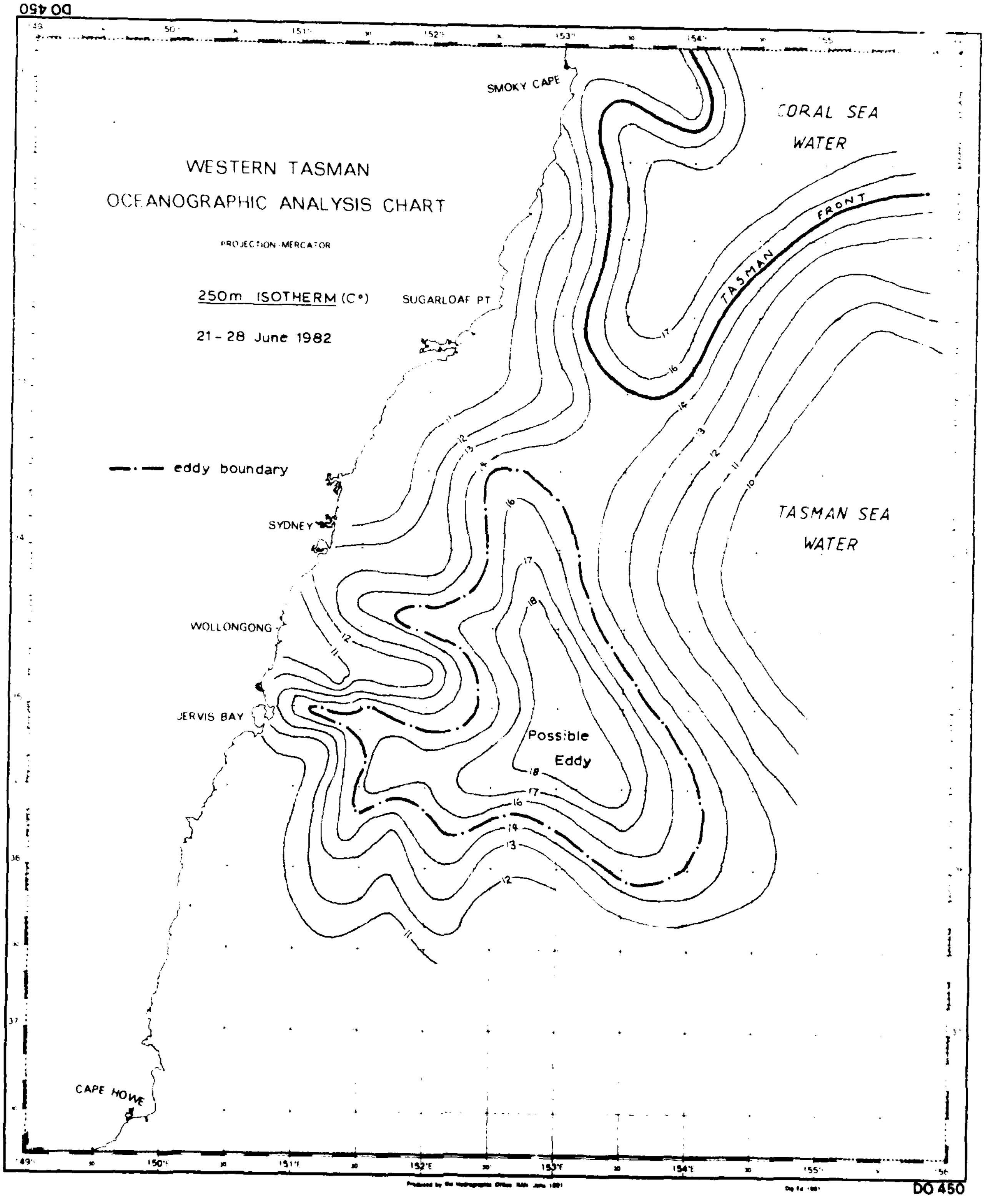
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
LAYER DEPTH (m)
21 – 28 June 1982
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
DO 450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WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION MERCATOR
250m ISOTHERM (C°)
21 - 28 June 1982
eddy boundary
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
CORAL SEA WATER
TASMAN FRONT
TASMAN SEA WATER
Possible Eddy
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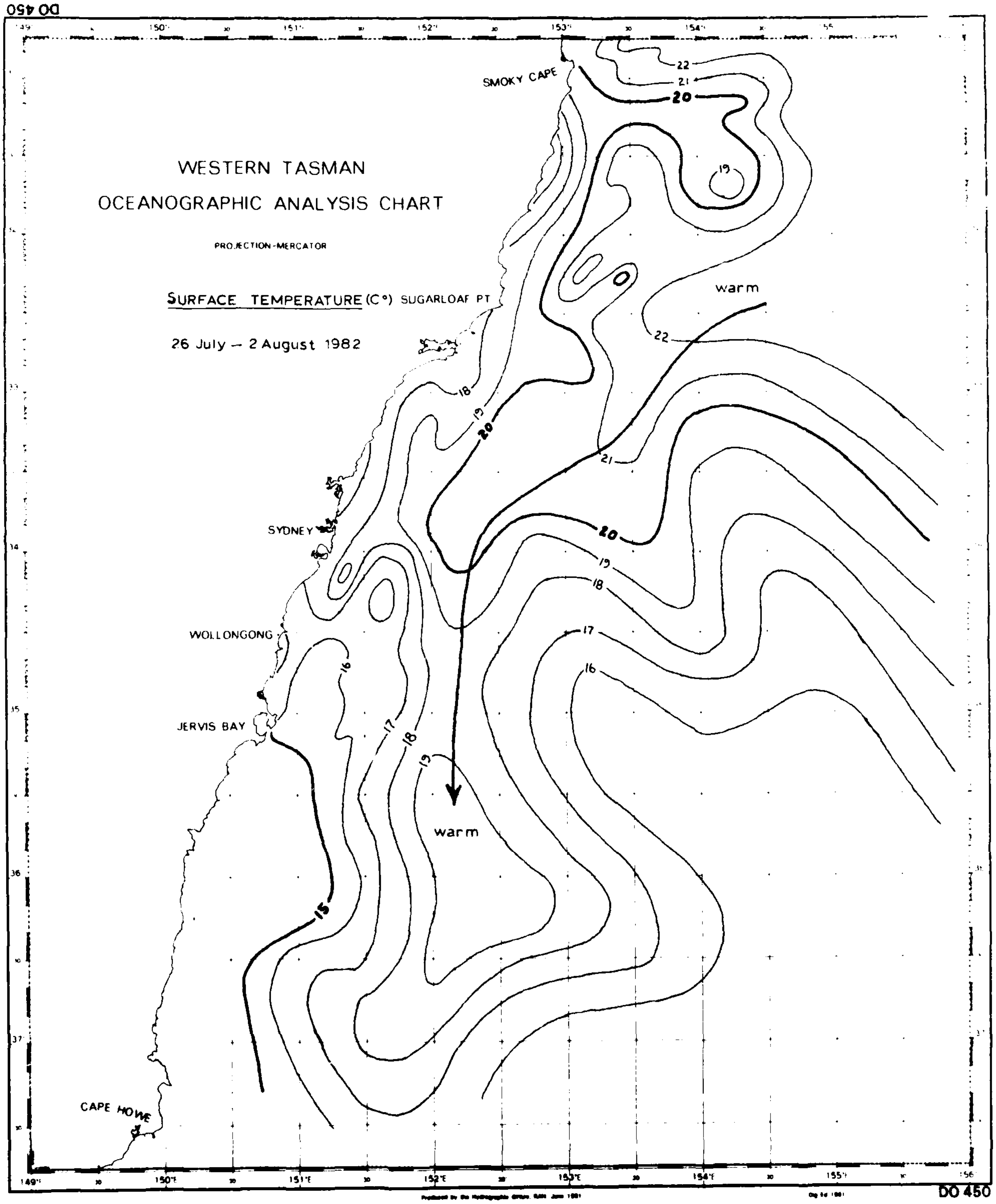
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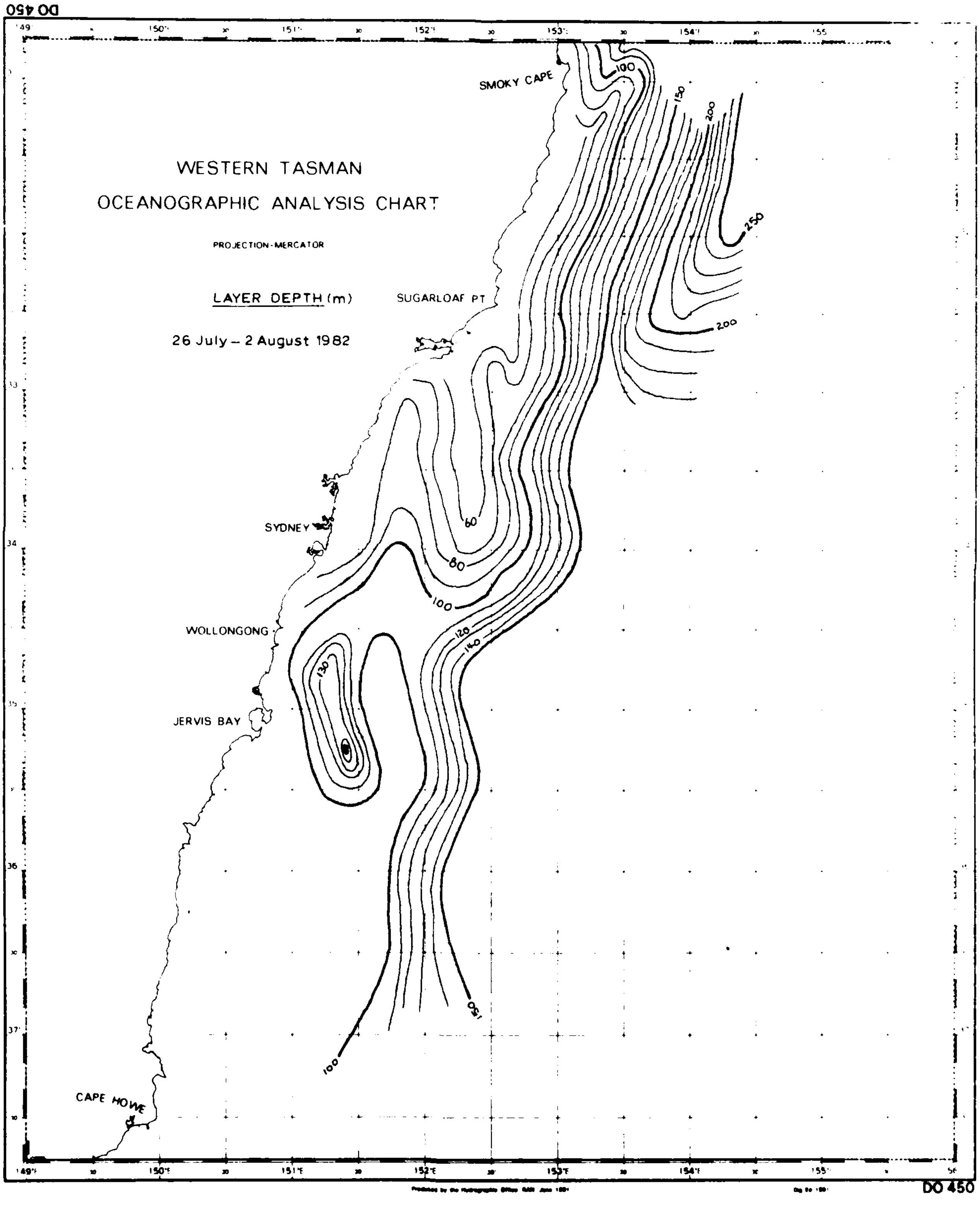
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
SURFACE TEMPERATURE (C°) SUGARLOAF PT
26 July – 2 August 1982
SMOKY CAPE
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
warm
warm
22
21
20
19
18
17
16
15
149°E
150°E
151°E
152°E
153°E
154°E
155°
DO 450



WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
LAYER DEPTH (m)
26 July – 2 August 1982
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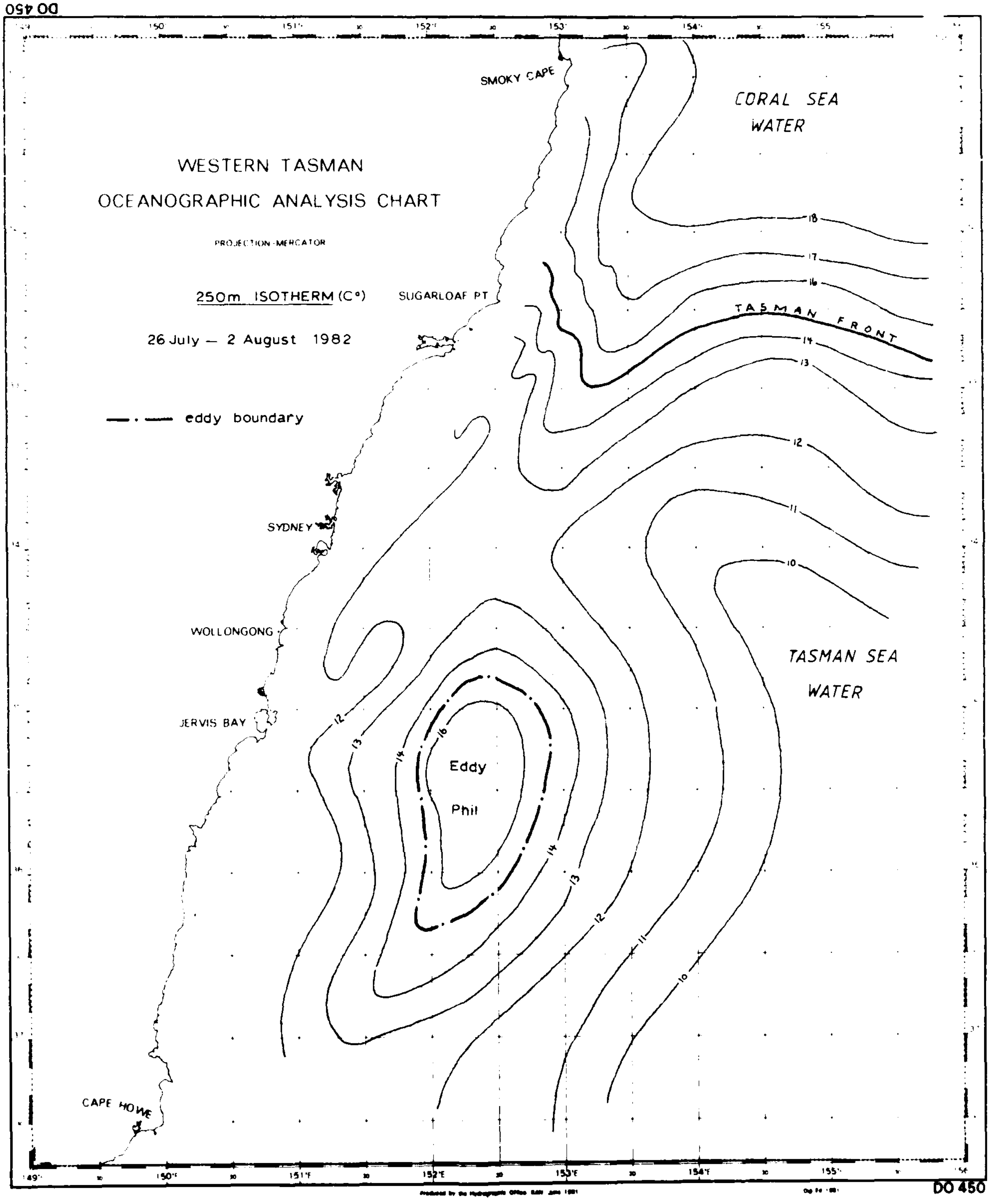
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
DO 450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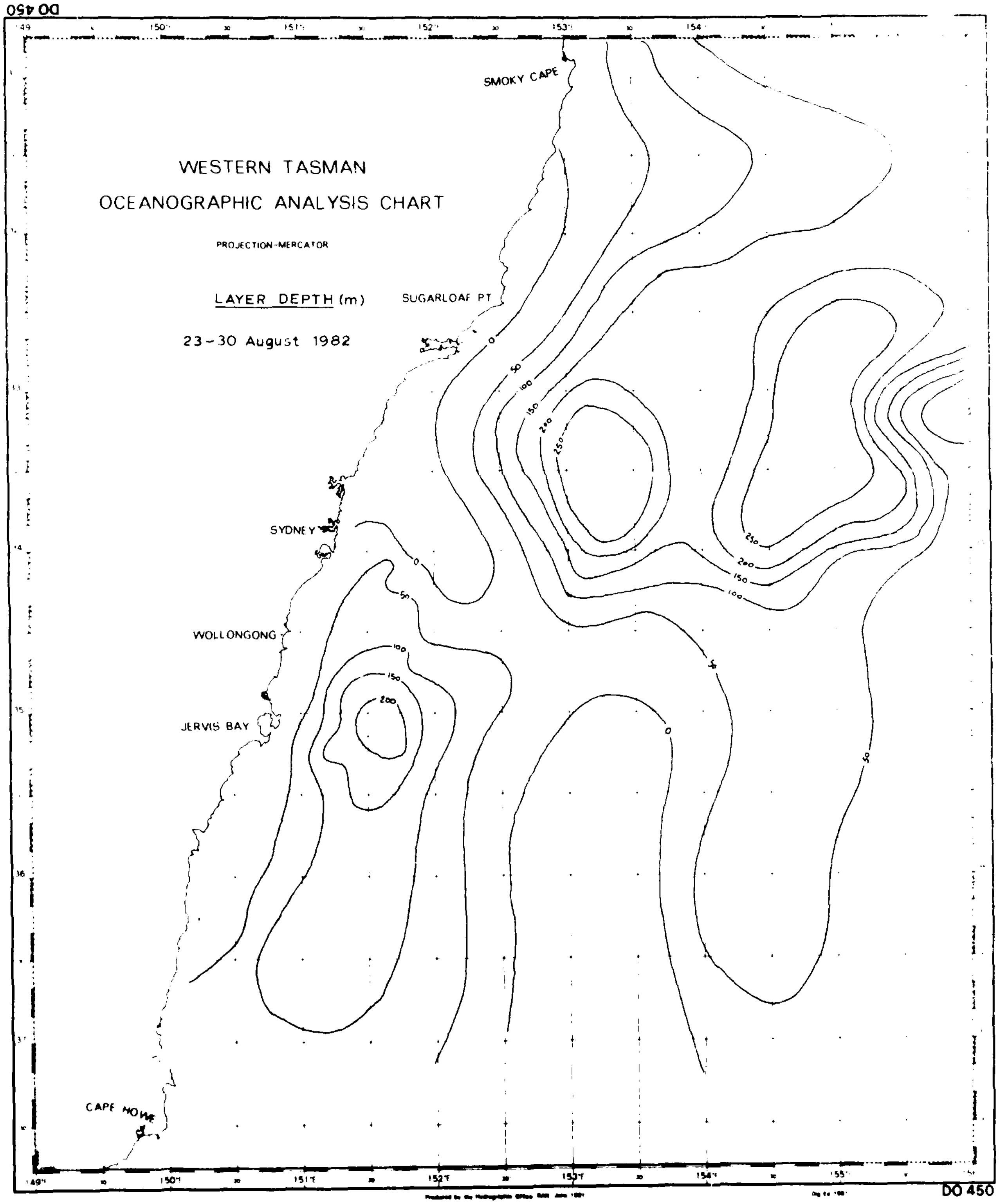
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
250m ISOTHERM (C°)
26 July — 2 August 1982
eddy boundary
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
CORAL SEA WATER
TASMAN FRONT
TASMAN SEA WATER
Eddy Phil
DO 450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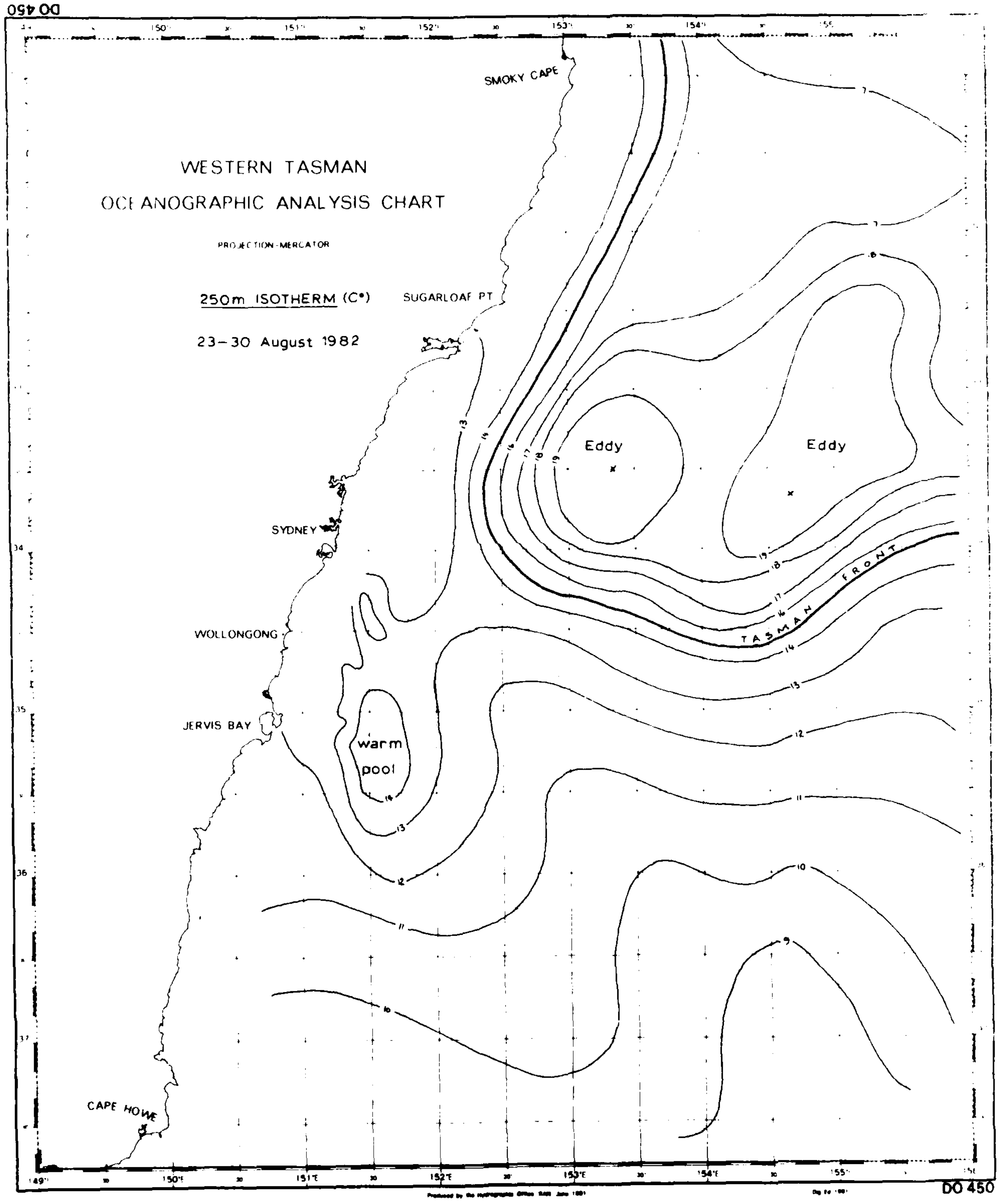
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
LAYER DEPTH (m)
23-30 August 1982
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
0
50
100
150
200
250
DO 450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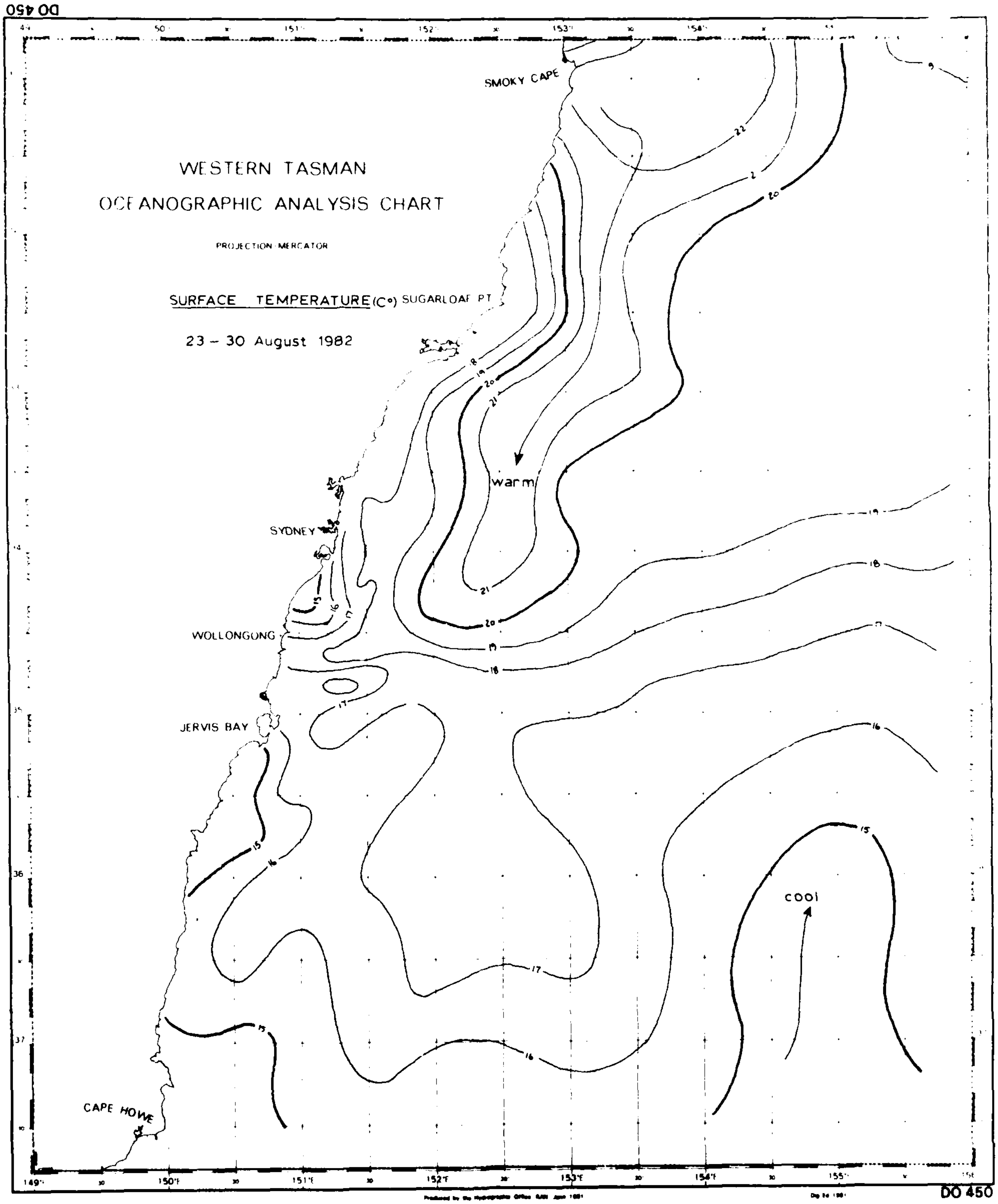
WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION-MERCATOR
250m ISOTHERM (C°)
23–30 August 1982
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
Eddy
Eddy
warm pool
TASMAN FRONT
150°E
151°E
152°E
153°E
154°E
155°
DO 450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WESTERN TASMAN
OCEANOGRAPHIC ANALYSIS CHART
PROJECTION MERCATOR
SURFACE TEMPERATURE (C°)
23 – 30 August 1982
SMOKY CAPE
SUGARLOAF PT
SYDNEY
WOLLONGONG
JERVIS BAY
CAPE HOWE
warm
cool
150°E
151°E
152°E
153°E
154°E
155°
DO 450

HYDROGRAPHIC SERVICE

Royal Australian Navy

AVAILABILITY OF RAN SHIPS

for

OCEANOGRAPHIC DATA COLLECTION

The Royal Australian Navy has a fleet of four Survey Ships. HMA Ships MORESBY & FLINDERS are engaged on full time hydrographic surveys and HMA Ships COOK and KIMBLA carry out oceanographic research.

Ship time may be made available to the civilian scientific community for oceanographic research. It is emphasised that priority is given to defence requirements, however every effort is made to accommodate requests for assistance. Assistance may range from underway data collection by ship's staff concurrently with the ship's main task to dedicated cruises with civilian scientist cruise leader and team embarked. To assist with planning a five year programme is published which details expected areas of operation and times on task.

Requests for ship time should be addressed to:

The Hydrographer, RAN,
Department of Defence (Navy Office),
Russell Offices,
CANBERRA ACT 2600

The ships' capabilities and equipments are described briefly over leaf, detailed information is available from:

The Hydrographic Office,
P.O. Box 1332,
NORTH SYDNEY NSW 2060
Telephone (02) 922.2888

Requests for ship time should include the following information:

1. originator and originator's distinguishing cruise reference number;
2. type of ship required;
3. specific area of cruise;
4. calendar date of cruise (if applicable);
5. days required on task;
6. liaison officer — name and telephone number;
7. time needed alongside;
8. onboard accommodation requirements;
9. whether shared use of the ship would be acceptable during the cruise;
10. brief description of proposed cruise including aspects for consideration in determining priorities.

HMAS MORESBY is a large modern survey ship. She operates her own helicopter and 3 survey motor boats. She is based in Fremantle; her area of operation is the West Coast from Darwin to Esperance.

Displacement	2530 tonnes		
Length overall	95.7 metres		
Beam	12.8 metres		
Draught	4.2 metres		
Propulsion system	Diesel electric 4000kw		
Cruising speed	15 knots		
Equipment	Crane 3 ton SWL	Oceanographic Winch	Satnav
	Davit [illegible] ton SWL	XBT system	Argo
	Windlass 10 ton SWL	Seabed sampling equipment	Miniranger
	Capstan 3 [illegible] ton SWL	Proton magnetometer	Echo sounders
	Oceanographic Laboratory	Current meter	Survey sonar
	Photographic Workshop	Transmissometer	Side scan sonar
Accommodation	Up to 4 berths		

HMAS FLINDERS was designed and built to conduct hydrographic surveys in Australian coastal waters. She is based at Cairns. She carries a 10 metre Survey Motor Boat, her area of operation is the Barrier Reef and the Gulf of Carpentaria.

Displacement	825 tonnes	
Length overall	49 metres	
Beam	10 metres	
Draught	3 metres	
Propulsion system	2 diesel engines, 2 shaft, 825 BHP	
Cruising speed	11.5 knots	
Equipment	General purpose crane, 3 tonnes	Argo
	Small boat davit	Mini ranger
	Oceanographic winch	Satnav
	XBT system	Echo sounders
	Seabed sampling equipment	Survey sonar
	Current meters	Side scan sonar
		Electromagnetic log
Accommodation	No recognised spare berths, but space for 5 could be made available for a short period	

HMAS KIMBLA is normally employed in oceanographic work. She is expected to be replaced by an ex-Department of Transport ship in 1985/86. Based in Sydney, she is limited by speed and fuelling constraints.

Displacement	1073 tonnes	
Length overall	55 metres	
Beam	9.8 metres	
Draught	[illegible].1 metres	
Propulsion system	Triple expansion, 1 shaft, 850hp	
Cruising speed	7 knots	
Equipment	Steam winches, fwd and aft,	Dry Laboratory
	10 tonnes SWL	Small wet laboratory
	Boom, 8 tonnes at 5.5 metre radius	Upper deck Nansen bottle stowage
	4 davits, 1 tonne & ½ tonne SWL	PDR
	Towing hook, 10 tonnes	Satnav magnavox 1122
	Oceanographic winch, 2000 metre, 500kg	
	XBT system	
Accommodation	Berths for 4 scientists	

HMAS COOK is a modern dedicated oceanographic research ship.

Displacement	2600 tonnes		
Length overall	96.6 metres		
Beam	13.4 metres		
Draught	4.0 metres, 5.2m with bow thruster extended		
Propulsion system	4 diesel engines, 3400 BHP		
	Bow thruster, 400HP		
	Active rudder, 300HP		
Cruising speed	14 knots		
Equipment	2 Hydrographic winches,	Wind speed & direction	Satnav
	10,000 metres, 3 tonnes	Barometer	Electromagnetic log
	Linear cable engine, 10,000lbs	Wet & dry bulb temperature	SNBESS – narrow beam echo sounder
	A Frame, pivots with 6000lb load	Pyranometer	
	Oceanographic winch, 10,000 metres,	Pyradiometer	Data centre
	30,000lb	Radiosonde system	Wet laboratory, salinometer
	XBT system		
	Nisken bottles		
	VCTOD		
	Waverider buoy		
	Thermosalinograph		
	SST		
Accommodation	Berths for 13 scientists		

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9 -